NEUROTHERM

RADIO FREQUENCY

LESION GENERATOR

MODEL JK3

Service Manual

Document No. R28.503

Using the NeuroTherm Stimulation Test Kit

Introduction

There are times when the cannula and thermocouples look to be properly positioned in the patient but the patient does not feel any stimulation.

The Stimulation Test Kit provides a positive test that the electrode and RF lesion generator are operating correctly. The test can be performed within the sterile field.

Preparation

Ensure that the Stimulator Test Kit is kept sterile and always available.

Contents
- Red cable
- Circular test block
- Blue sterilising tray
- Instructions for use

Sterelisation Instructions

After use the Stimulation Test Kit should be cleaned as per institutional policy using any normally available cleansing agent.

Sterilize by autoclave as for porous materials. Maximum permitted temperature 140°C.

Check Thermocouple

When the thermocouple is plugged into the JK3 the red LED labelled THERMOCOUPLE will turn green. When inserted into the cannula the temperature reading on the JK3 in TEST or in LESION mode will read between 35° and 38°C.

Check the Reference Plate

Ensure that the reference plate is properly connected. With the thermocouple and cannula in place in the patient check the IMPEDANCE.

Check the Stimulation

Plug the red test lead into the JK3 and the other end into the test round block. Place the test block on the sterile trolley.

Switch the JK3 into STIMULATOIN mode, set to 100 Hz or 3 Hz, turn up the amplitude and note the meter increases up to 2 Volts approximately.

Remove the sterile thermocouple from the patient, the cannula can stay in place, and touch the end of the thermocouple onto the sterile block.

With the amplitude turned up a buzz (100 HZ) or a tick (3 Hz) will be heard.

This is proof positive that the stimulation voltage is actually being delivered to the tip of the cannula.

Repositioning the Electrode

If all is correct with the machine and electrodes then the position of the cannula is suspect. Continue to reposition until the patient feels the stimulation.

If a satisfactory threshold cannot be found turn up the stimulation voltage to 0.5 Volt (or 1 Volt) and keep the stimulation on while the needle is slowly moved around. Ensure an assistant is ready to turn the amplitude down or off as soon as stimulation is felt as it can be painful for the patient. When stimulation is felt properly test for the sensory threshold turning up from zero

1. CONTENTS

1.1 Contents
1.2 List of Figures

2. WARNINGS AND CAUTIONS

3. INTRODUCTION AND APPLICABILITY OF THIS MANUAL
3.1 Introduction and applicability of this manual
3.2 Summary of Equipment Revision Changes
3.3 Summary of Board Revision Changes
3.3.1 Revision A - All Boards
3.3.2 Revision B - August 1993
3.3.3 Revision C – December 1998 Model JK3
3.4 Manual Updates
3.4.1 Neurotherm Radio Frequency Lesion Generator Unit Manual Changes
3.4.2 Record of Manual Updates carried out

4. GENERAL DESCRIPTION
4.1 Specification
4.2 Principle of Operation
4.2.1 Theory of Neuro-Surgical Radio Frequency Lesioning
4.2.2 The Active and Passive Electrodes
4.2.3 The Surgical effects of Radio Frequency Lesioning
4.2.4 Lesioning
4.2.5 Monopolar and Bipolar Lesioning
4.3 General Block Diagram
4.4 Wiring Diagram
4.5 Rear Connector Configuration
4.6 Front Panel Connections

5.0 DETAILED DESCRIPTION OF MODULES
  5.1 Power Supply Unit Board No. 2800808001C
  5.2 Fuse Board No. 2800808001D
  5.3 Impedance Board No. 2800808002
  5.4 Stimulate Board No. 2800808003
  5.5 RF Generator Board No. 2800808004
  5.6 RF Voltage and Current Metering Board No. 2800808005
  5.7 Temperature Board No. 2800808006
  5.8 Timer and Interlock Board No. 2800808007
  5.9 Counter Interface Board No. 2800808008
  5.10 System and Layout and Wiring (2800809001)

6.0 CIRCUIT DIAGRAMS AND PARTS LISTS
  6.1 Power Supply Unit Board – 2800808001C
  6.2 Fuse Board – 2800808001D
  6.2 Impedance Board - 2800808002
  6.3 Stimulate Board - 2800808003
  6.4 RF Generator Board - 2800808004
  6.5 RF Voltage and Current Metering Board - 2800808005
  6.6 Temperature Board - 2800808006
  6.7 Timer and Interlock Board - 2800808007
  6.8 Counter Interface Board - 2800808008
  6.9 General Systems Schematic - 2800809001

7.0 SERVICE AND TROUBLESHOOTING
  7.1 General Service Information
  7.2 Disassembly and Reassembly
  7.3 Troubleshooting
    7.3.1 Basic Troubleshooting
    7.3.2 Further Troubleshooting

8.0 ADJUSTMENTS
- 8.1 Adjustments after component replacements
- 8.2 Impedance Board (2800808002) Adjustments
- 8.3 Stimulate Board (2800808003)
- 8.4 Voltage and Current Metering (2800808005) Adjustments
- 8.5 Temperature Board (2800808006) Adjustments
- 8.6 Timer and Interlock Board (2800808007) Adjustments

9.0 FUNCTIONAL FIELD CHECK PROCEDURES

10.0 SPARE PARTS
- 10.1 Spare Parts

11.0 EARLIER REVISIONS

LIST OF FIGURES

4.1 Output Power/Load Resistance Curves
4.2 Maximum available Stimulate Output Voltage/Load Resistance Curve
4.3 Simplified Block Diagram

5.1 Power Supply Unit - Circuit Diagram
5.2 Block Diagram - Impedance Circuit
5.3 Impedance Board - Circuit Diagram
5.4 Stimulate Board - Circuit Diagram
5.5 Typical Stimulate Waveform
5.6 RF Generator Board - Circuit Diagram
5.7 Typical Lesioning Waveform
5.8 RF Voltage And Current Metering Board - Circuit Diagram
5.9 Temperature Board - Circuit Diagram
5.10 Relationship between Thermocouple Input and Amplifier Output Signals
5.11 Timer and Interlock Board - Circuit Diagram
5.12 Counter Interface Board - Circuit Diagram
5.13 System Wiring - Circuit Diagram
5.14 Voltages on Circuit Boards related to position of Main Function Switch

6.1 Power Supply Board - 2800808001 - Circuit Diagram
6.2 Power Supply Board - 2800808001 - Component Layout
6.3 Impedance Board - 2800808002 - Circuit Diagram
6.4 Impedance Board - 2800808002 - Component Layout
6.5 Stimulate Board - 2800808003 - Circuit Diagram
6.6 Stimulate Board - 2800808003 - Component Layout
6.7 RF Generator Board - 2800808004 - Circuit Diagram
6.8 RF Generator Board - 2800808004 - Component Layout
6.9 RF Voltage and Current Metering Board - 2800808005 - Circuit Diagram
6.10 RF Voltage and Current Metering Board - 2800808005 - Component Layout
6.11 Temperature Board - 2800808006 - Circuit Diagram
6.12 Temperature Board - 2800808006 - Component Layout
6.13 Timer and Interlock Board - 2800808007 - Circuit Diagram
6.14 Timer and Interlock Board - 2800808007 - Component Layout
6.15 Counter Interface Board - 2800808008 - Circuit Diagram
6.16 Counter Interface Board - 2800808008 - Component Layout

6.17 Fuse Board - 2800808001D – Circuit Diagram
6.18 Fuse Board - 2800808001D – Component Layout
6.19 General System Schematic - 2800809001 - Circuit Diagram

2.0 WARNINGS AND CAUTIONS

Warning indicates a potentially harmful situation to yourself or others.

HAZARDOUS ELECTRICAL OUTPUT: The equipment is for use **ONLY** by qualifie medical personnel.

Do **NOT** under any circumstance, perform any testing or maintenance on the equipme while it is being used on a patient.

Do **NOT** use extension cords or adapters of any type. The power cord and plug must b intact and undamaged.

Should the power cord or plug become cracked, frayed, broken of otherwise damaged, must be replaced immediately.

If the equipment has in any way suffered mechanical damage it should be returned to th Supplier for Inspection and Test before further use.

Unplug the power cord before cleaning or service.

The operator should not perform any servicing of the equipment. Any servicing should onl be carried out by qualified personnel.

EXPLOSION HAZARD: Never use this equipment in the presence of flammabl anesthetics.

ELECTRIC SHOCK HAZARD: Always turn the equipment off before cleaning and **D** **NOT** allow **ANY** fluid to enter the ventilation holes or sockets.

ELECTRIC SHOCK HAZARD: Do not touch any exposed wiring or conductive surface while cover is off and the equipment is energised. The voltage present when the electri power is connected to the equipment can cause injury or death. **Never** wear a groundin wrist strap when working on energised equipment.

FUSE REPLACEMENT: For continued protection against fire hazard, replace only wit same type and rating of fuse as displayed on the rear Serial Number Plate.

2.0 WARNINGS AND CAUTIONS (continued)

A CAUTION indicates a condition that may lead to equipment damage or malfunctior

Servicing of the equipment in accordance with this service manual should never t undertaken in the absence of proper tools, test equipment and the most recent revision c this service manual which is clearly and thoroughly understood.

When repairing circuit boards, great care should be taken in handling boards as all boarc contain static sensitive devices. Before servicing a board, ground yourself and the relevai tool to discharge any accumulated static charge by wearing a wrist strap and placing th board on a static mat. If a board has to be returned, use anti-static bags or containers.

The tests and repairs outlined in this manual should only be attempted by trained personne Unauthorised service may void the warranty of the unit.

Check the voltage rating on the rear Serial Number Plate before connecting the equipment t AC Mains Power. The equipment must never be operated at the wrong mains voltage.

Use insulated tools when adjusting the internal controls on the equipment.

When cleaning the outer casing or display panel of the equipment do not use abrasive agent or solvents.

3.0 INTRODUCTION AND APPLICABILITY OF THIS MANUAL

3.1 Introduction and applicability of this manual

This service Manual (Document No. R28.503) gives the information required tc maintain and repair the Neurotherm Radio Frequency Lesion Generator Unit Model JK3. The main body of this manual deals with the present productior revision of the equipment. Differences between equipment revision ar summarised in Section 3.2. Section 3.3 lists the technical changes made to th equipment.

The revision of the whole equipment is changed if such technical changes are mad which make some spare parts incompatible with earlier units. The initial equipmen numbering, as shown on the rear Serial Number Plate contains no revision lette (e.g. Serial No. R18-101-98) however later revisions will contain a revision lette (eg. Serial No. R18-101-98 Rev A). If the whole machine is upgraded such tha early machines cannot be easily amended, then the upgraded machines will star from a nominated serial number as indicated in Section 3.2.

Within the equipment, function units such as Printed Circuit Boards will b changed or updated from time to time, these may or may not introduce a revision o the whole equipment. Each printed circuit board contains an identity number and serial number of the board together with the issue number - designated by a lette The initial issue letter was A for all Boards. In all cases the spare parts order cod is also the Board Identity Number and Issue Number (e.g. 2800808002).

In order to understand this manual it is necessary to have a complete understandin of the function and operations of the Lesion Generator Machine. This informatio can be obtained from the Operators Manual which contains full operatin instructions.

3.2 Summary of Equipment Revision Changes

Initial production revision of this equipment – Model JK2

Revision - August 1993

Serial No's from R18-009 onwards

Incorporation of Digital displays and digital timing

Upgraded Boards. Major internal rewiring

Power Supply Board	2800808001 B
Impedance Board	2800808002 B
Stimulate Board	2800808003 B
Timer and Interlock Board	2800808007 B
General System Schematic	2800809001 B

New Board - Counter Interface Board 2800808008 A

In December 1998, the equipment was changed to Model JK3.

The Serial Nos started from R18-101-98.

The major differences from Model JK2 were

a) New case
b) New Fuse Board 2800808001D
c) New Stimulate Board 28008003C
d) New Temperature Board 28008006D
e) New Timer and Interlock Board 28008007D
f) Modified Counter Interface Board 28008008C

The board changes added a number of features to the functions of the JK2 machine

1 Two more temperature limits, 70°C and 80°C were added to the existin one, 90°C on the Lesion Function.
2 A Pulsed RF function was added
3 The Stimulation Rate LED is now controlled by the Interlock Circuit
4 A test socket and a test block is provided to give audio confirmation th stimulation pulses are present.

3.3 Summary of Board Revision Changes

3.3.1 Revision A - All Boards Model JK2

Initial production revision of this equipment

3.3.2 Revision B - August 1993 Model JK2

Power Supply Board 2800808001 B

5 volt supply added for Lamps and Meters
40 volt rectifier moved onto Board

Impedance Board 2800808002 B

221 and C220 added to smooth impedance display

Stimulate Board 2800808003 B

Digital Display Interface added
Interlock added to prevent stimulate output when initially switche to stimulate function

Timer and Interlock Board 2800808007 B

New Board Design to operate digital timer

Counter Interface Board 2800808008 A

3.3.3 Revision C – December 1998 Model JK3

Power Supply Board 2800808001C

5 Volt supply changed to Switch Mode
Fuses removed from Board

Fuse Board 2800808001D

The fuses for the 4 supplies are on this Board

Stimulate Board 2800808003C

Detector Circuit added to give audio confirmation of presence of pulse

Temperature Board 2800808006D

Two extra temperature limits added (70°C and 80°C)
Pulsed RF added

Timer and Interlock Board 2800808007D

Several relays removed from Board and replaced by integrated circuits
Functions unchanged

3.4 Manual Updates

3.4.1 Neurotherm Radio Frequency Lesion Generator Unit Manual Changes

This is the JK3 manual applicable to the machines from serial number shown below:-

Issue No.	Page	Change	Date
1		As Issued	May 1999

3.4.2 Record of Manual Updates carried out

Update Number	Carried out by Name	Date

4.0 GENERAL DESCRIPTION

4.1 Specifications

Size:	
Width	400mm (15.7")
Height	172mm (6.8")
Depth	430mm (16.9")
Weight:	
8.9kg	(19.5lbs)
Electrical:	
UK	240 volts 50Hz Fused 1 ampere on live and neutra
USA	110 volts 60Hz Fused 2 ampere on live and neutra
	The power supply is built to Class 2 standard. Th mains transformer and all mains related parts ar doubly insulated from the Main Enclosure. Th mains transformer has separate isolated bobbins fo mains and low voltage windings. It also has thermal fuse built into the primary winding th will fail at 125°C should overheating occur. Th instrument is not connected to mains earth. (Clas 2).
Standards:	This instrument complies with BS 5724, EC 601 – 1 and MDD 93/42/EEC.
Impedance:	
Measuring frequency	53KHz (± 5KHz)
Measuring source voltage	Less than 500 mV AC
Digital Display	0-2000 ohms (in 1ohm steps)
Meter Reading	Meter reads biological impedance
Lamp Indicator	Amber LED lights when this facility is in circuit
Self Test	500 ohms resistor built into machine

4.1 Specifications (continued)

Stimulator:

Voltage Amplitude	Continuously Variable between 0 and 2 volts. Th voltage supplied is displayed on the Digital Mete in 0.01 volt steps.
Pulse Rates	3 and 100 pulses per second Accuracy ±5% of reading
Pulse Width	1 mSec at 100 Hz
Wave Form	Biphasic pulses. Negative Pulse leading
Lamp Indicator	Green LED flashes at pulse rate of 3Hz and is continuous at a pulse rate of 100Hz.
Safety Interlock	Stimulation voltage cannot be delivered unless the voltage control is first set to the off position; this prevents any accidental application of stimulation voltage. If the stimulation section is selected and voltage control is on, the display and output will stay at zero, and the LED will not flash.

RF Lesion Power:

RF Frequency	300KHz (±10%) sine wave.
Power Output	Continuously variable. Maximum power output 8 watts into 200 ohm
Voltmeter	0 - 40 RF volts (RMS)
Milliampere	Meter 0 - 200 RF milliamps (RMS)
Self Test	Into 200 ohm dummy load resistance built into machine
Lamp Indicators	Red LED lights when this facility is in circuit. Second red LED flashes when Lesion Power is switched on.

4.1 Specifications (continued)

Lesion Timer:

Range	Timer counts down from preset times of 60,90, 12 and 180 seconds. Timer stops when lesion powe is turned off. Timer can be restarted when lesio power is established. Turning the Function switc to any position other than "Lesion" resets the tim to its set point.
Lamp Indicator	Clock indicates amount of time remaining for lesioning. At the end of the preset period an alarm tone sounds and power is removed from the needl Tone can be stopped by turning the Lesion power to the OFF position. Timer resets to set point for the next lesion.
Audible Indicator	A one second "tick" indicates the clock is running.

Temperature Monitor:

Meter Range	30°C to 100°C

Probes:

Use only Rocket-Ker Thermocouple Probes	No individual adjustment necessary.

Safety Features:

Safety Cut Out	Lesion Power is automatically cut off if Temperature reaches the level set by the maximun Temperature Control. Lesion Power wi automatically cut back in once the temperature c the tip of the probe drops 2°C less than th maximum temperature selected.
Safety Interlock	Lesion Power cannot be delivered unless the RF Power control is first set to the OFF position, this prevents any accidental application of the RF power. If the lesion power is selected and power control is on, a high pitched warning tone is given out.

4.1 Specifications (continued)

	Earth Leakage Data	Typical	Maximum Allowable
1	Enclosure leakage current		
	Normal	3 microamps	100 microamps
	Reverse	4 microamps	100 microamps
	Single fault condition		
	Normal	0 microamps	500 microamps
	Reverse	10 microamps	500 microamps
2	Patient leakage current		
	Normal	4 microamps	100 microamps
	Reverse	5 microamps	100 microamps
	Single fault condition		
	Normal	0 microamps	500 microamps
	Reverse	10 microamps	500 microamps
3	Patient Auxilliary Current		
	Normal	1 microamp	10microamps
	Reverse	2 microamps	10 microamps
	Single fault condition		
	Normal	0 microamps	500 microamps
	Reverse	5 microamps	500 microamps
4	Patient leakage with applied mains		
	Normal	0 microamps	5000 microamps
	Reverse	0 microamps	5000 microamps
5	Patient Leakage with mains applied antiphase		
	Normal	0 microamps	5000 microamps
	Reverse	0 microamps	5000 microamps

Figure 4.1 Output Power/Load Resistance Curve

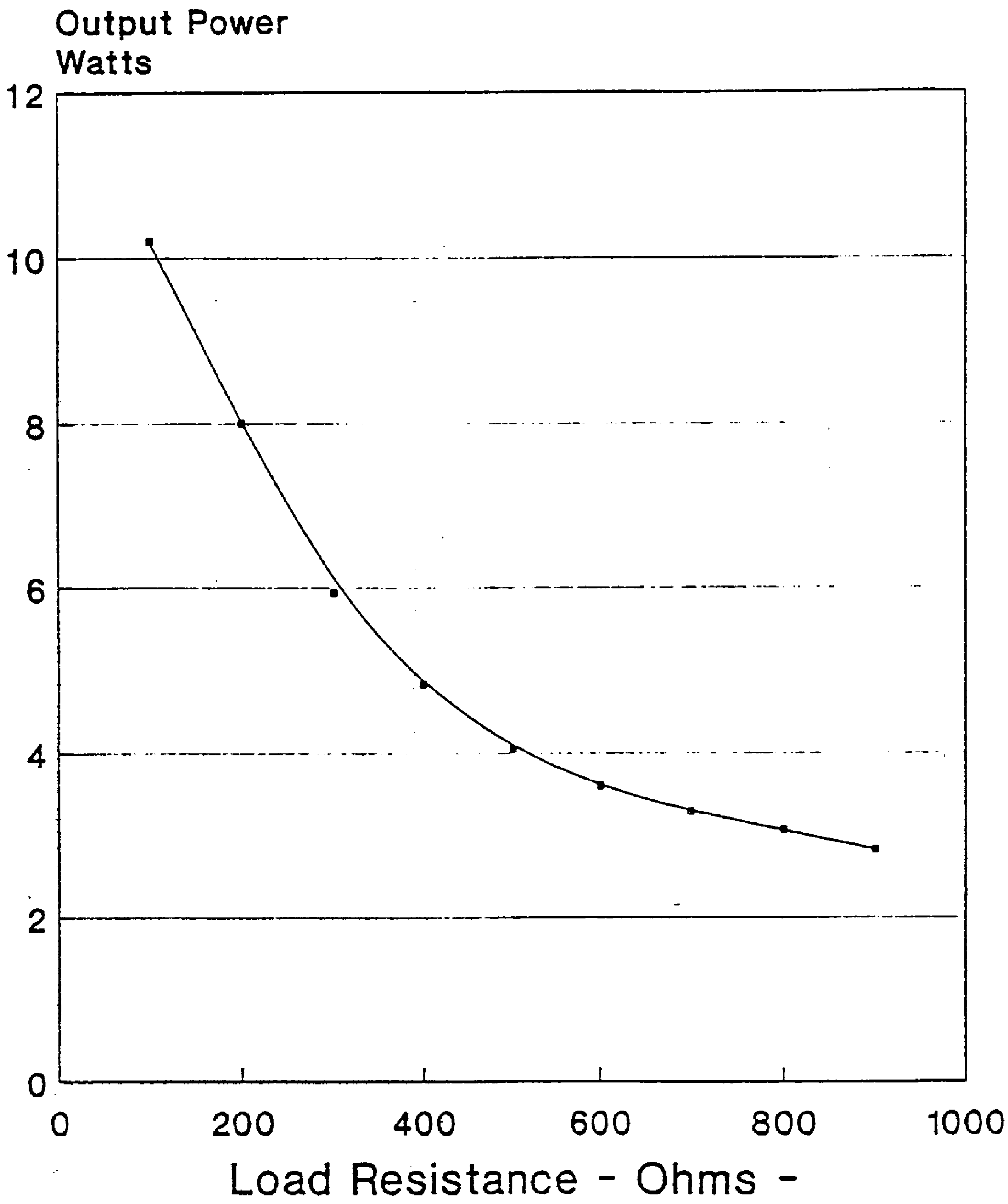
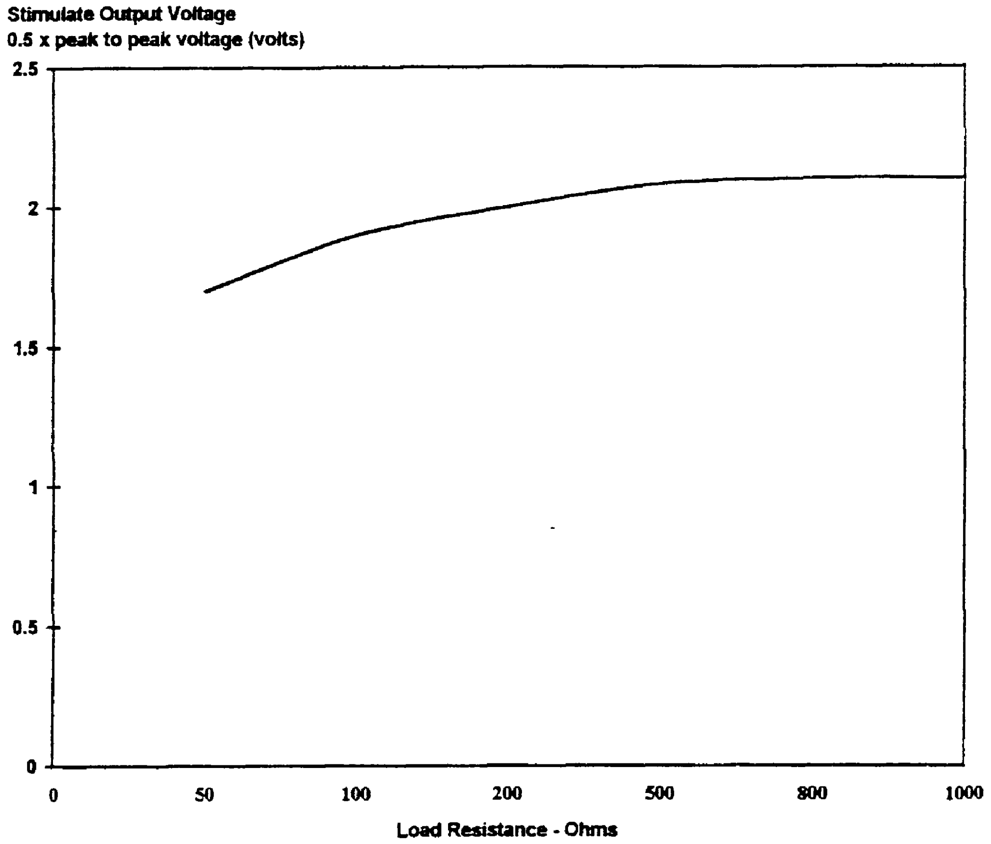


Figure 4.2 Maximum available Stimulate Output Voltage/Load Resistance Curve

Load Resistance	Stimulate Output Voltage
0	
50	1.7
100	1.9
200	2
500	2.08
800	2.10
1000	2.10



4.2 Principle of Operation

4.2.1 Theory of Neuro Surgical Radio Frequency Lesioning

Definition

RADIO FREQUENCY LESIONING IS DEFINED AS THE HEATIN EFFECT PRODUCED BY THE PASSAGE OF HIGH FREQUENC ELECTRIC CURRENT THROUGH A BODY

Surgical RF Lesioning uses the properties of high frequency (RF) current to produce controlled heating capable of producing limited lesions in o around nervous tissue. Further, this radio frequency lesion generator ha the capacity of accurate temperature measurement of the actuator tip making precise temperature and time controlled lesions.

The body will conduct any electrical current, however, the amount o stimulation the tissue receives - particularly muscle and nerve fibres i generally inversely proportional to the frequency. It follows therefore tha the passage of mains electricity: 240V at a frequency of 50 cycles pe second (50Hz) through the body will cause intense muscle reaction, indee if passed directly through the heart, it may cause Cardiac Arrest.

However the passage of a current of 2000V at a frequency of 2.5 millio cycles per second (2.5MHz) would only cause local heating at the point o contact. High frequency currents (over 1.0MHz) give good lesion effect but are difficult to confine to wires and are prone to interfere wit surrounding electrical equipment such as ECG monitors etc. For thes reasons the system operates at 300KHz, as a compromise between thes two extremes.

4.2.1 Theory of Neuro Surgical Radio Frequency Lesioning (continued)

History

The use of radio frequency (rf) heat in lesion making has proved to be the most popular method of local destruction of bodily nervous tissue although a number of other methods have been extensively researched.

The reason that RF lesioning is preferred to other methods such as cryogenics, focused ultrasound and chemical injection is because:-

1) RF heat lesion volumes tend to have smooth and well-circumscribed bounding surfaces;
2) RF lesion sizes can be reproducibly quantified using temperature monitoring of the tip of the lesion electrodes;
3) unwanted side effects such as boiling, charring and sticking can be avoided by temperature monitoring;
4) because of the easy application of stimulation, impedance monitoring and recording, target localisation and stability of RF electrode positioning are easier to accomplish;
5) RF lesion electrodes are robust and easily made in different configurations to suit specific anatomical usages.

4.2.1 Theory of Neuro Surgical Radio Frequency Lesioning (continued)

Operation

RF voltage is connected between an 'active' electrode and a 'dispersive electrode with the bodily tissue completing the electrical circuit, the R current then flows through the tissue. The electric field created by the R voltage creates an electric force on the ions in the tissue electrolyte causing them to move back and forth at the RF. Frictional dissipation o the ionic current within the fluid medium causes tissue heating. This is th origin of the RF heat lesion.

The temperature varies as a function of distance from the electrode. It is between 45 - 50°C that boundary neural tissue is killed. Assuming uniform medium, the two most important parameters in determining th temperature distribution are the temperature next to the electrodes surfac and the radius of the electrode. The electrode's tip length determines th length of the lesion.

The RF heat is generated in the tissue, not in the electrode tip, and becaus the tip lies in the tissue, it absorbs heat from it. The electrode does n absorb much heat from the tissue, therefore at equilibrium the ti temperature nearly equals that of the hottest tissue adjacent to it.

Temperature is the fundamental lesioning parameter. By monitoring th electrode temperature and choosing the proper electrode size, mor consistent and safer lesions can be made, and adverse effects which ar caused by the overheating of the bodily tissue, such as boiling, charrin and sticking can be avoided.

4.2.2 The Active and Dispersive Electrode

As is common with most electrical circuits Radio Frequency units hav two electrodes - the output or ACTIVE electrode and the PASSIVE o DISPERSIVE electrode for returning the current to the machine.

The level of heat generated is dependent upon two factors:-

i) The amount of electrical power applied
ii) The surface area of the electrodes in contact with the body.

The ratio between these two factors is termed: CURRENT DENSITY

It follows that the smaller the surface area of the electrodes, the greater th current density will be for a given amount of power applied. The greate the current density - the greater the localised heating effect.

4.2.3 The Surgical effects of Radio Frequency

As the high frequency current is passed through the body tissue, heat i generated in the tissue around the point of contact. As the TISSUI becomes heated, the intracellular water is slowly driven out of the tissu and localised destruction of the nervous tissue occurs. Within th temperature range 45 - 50°C neural tissue is killed.

The Lesion size is critically dependent on the temperature isotherm around the electrode tip and the electrode tip size.

4.2.4 Lesioning

A high frequency current is passed through the body, as all animal tissue present a natural resistance to the flow of current, heat is generated in th tissue around the point of contact. When the tissue becomes heated, th intracellular water is slowly driven out of the tissue, and the tissue dies.

4.2.5 Monopolar and Bipolar Lesioning

There are two types of surgical radio frequency lesioning in use, they ar termed: MONOPOLAR and BIPOLAR.

Although in general for pain work monopolar lesioning is used, there is n practical difficulty in using Bipolar if the need should arise.

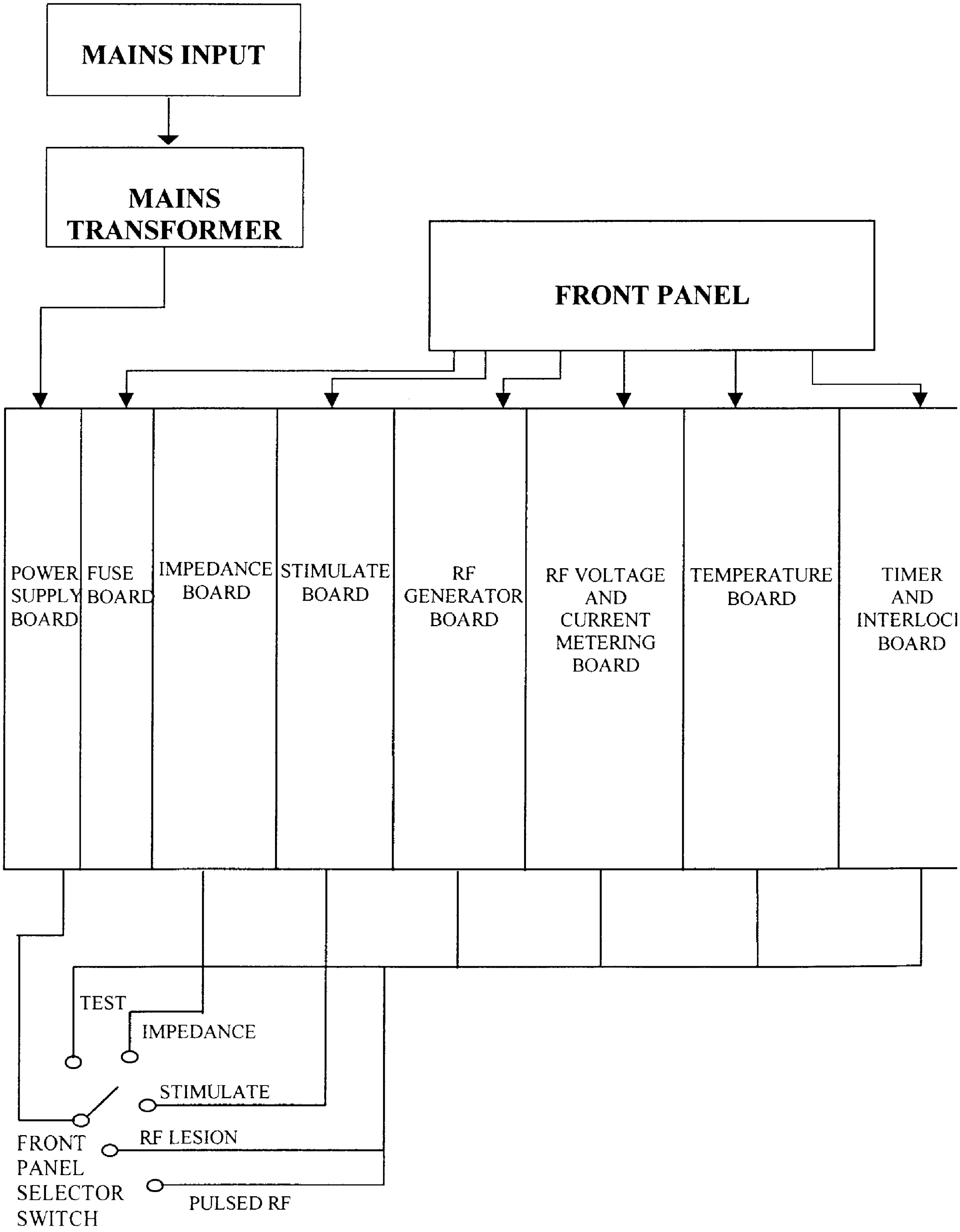
An example of Biploar operation is when lesioning the lumba communicating branch of the posterior primary ramus. Here a secon 2mm bare tip insulated probe is inserted and this probe is connected to th Dispersive Plate with a separate sterile lead. If following careful testing satisfactory differential is apparent RF power can be delivered.

4.3 General Block Diagram

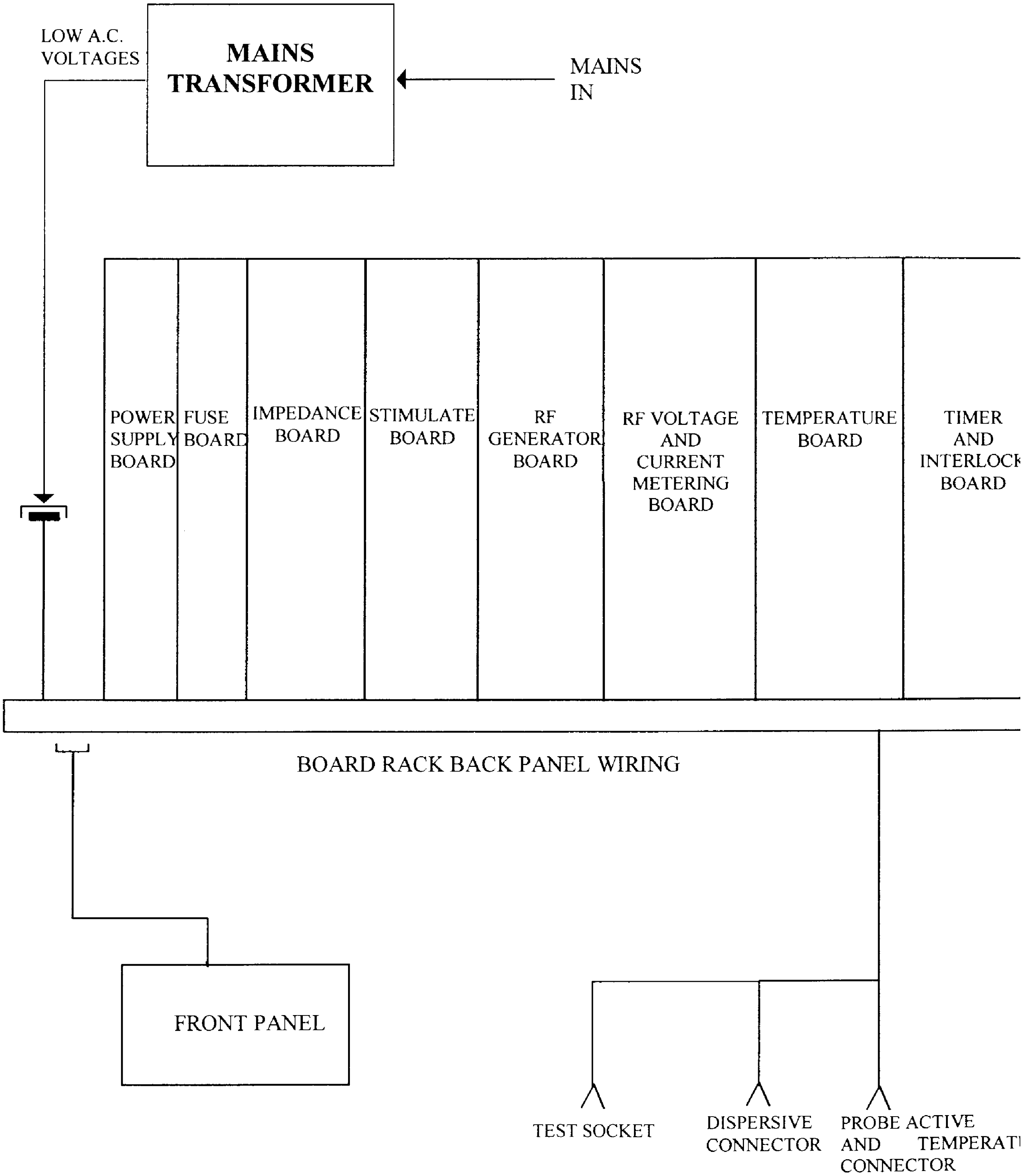
The Neurotherm Radio Frequency Lesion Generator consists of the followin modular parts (see Figure 4.3):-

Mains Input Transformer	
Fuse Board	(2800808001D)
Power Supply Board	(2800808001C)
Impedance Board	(2800808002)
Stimulate Board	(2800808003)
RF Generator Board	(2800808004)
RF Voltage and Current Metering Board	(2800808005)
Temperature Board	(2800808006)
Timer and Interlock Board	(2800808007)
Counter Interface Board	(2800808008)
Front Panel Assembly and Circuit Board Rack Wiring	(2800809001).

Figure 4.3 Simplified Block Diagram

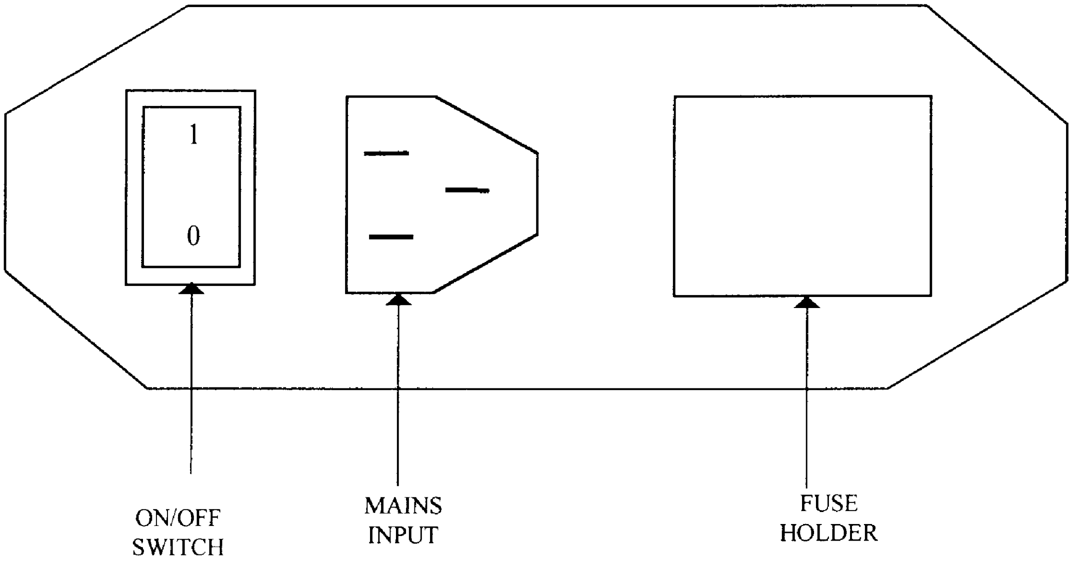

MAINS INPUT
MAINS TRANSFORMER
FRONT PANEL
POWER SUPPLY BOARD
FUSE BOARD
IMPEDANCE BOARD
STIMULATE BOARD
RF GENERATOR BOARD
RF VOLTAGE AND CURRENT METERING BOARD
TEMPERATURE BOARD
TIMER AND INTERLOCI BOARD
TEST
IMPEDANCE
STIMULATE
RF LESION
PULSED RF
FRONT PANEL SELECTOR SWITCH

4.4 Wiring Diagram


LOW A.C.
VOLTAGES
MAINS TRANSFORMER
MAINS IN
POWER SUPPLY BOARD
FUSE BOARD
IMPEDANCE BOARD
STIMULATE BOARD
RF GENERATOR BOARD
RF VOLTAGE AND CURRENT METERING BOARD
TEMPERATURE BOARD
TIMER AND INTERLOC
BOARD
BOARD RACK BACK PANEL WIRING
FRONT PANEL
TEST SOCKET
DISPERSIVE CONNECTOR
PROBE ACTIVE AND TEMPERAT
CONNECTOR

4.5 Rear Connector Configuration

Rear Panel Mains Input Connection



1 MAINS ON/OFF SWITCH

This is a rocker type switch, combined with an I.E.C connector socket with twi 'in-line' anti-surge fuses in a single unit to BS 4265.

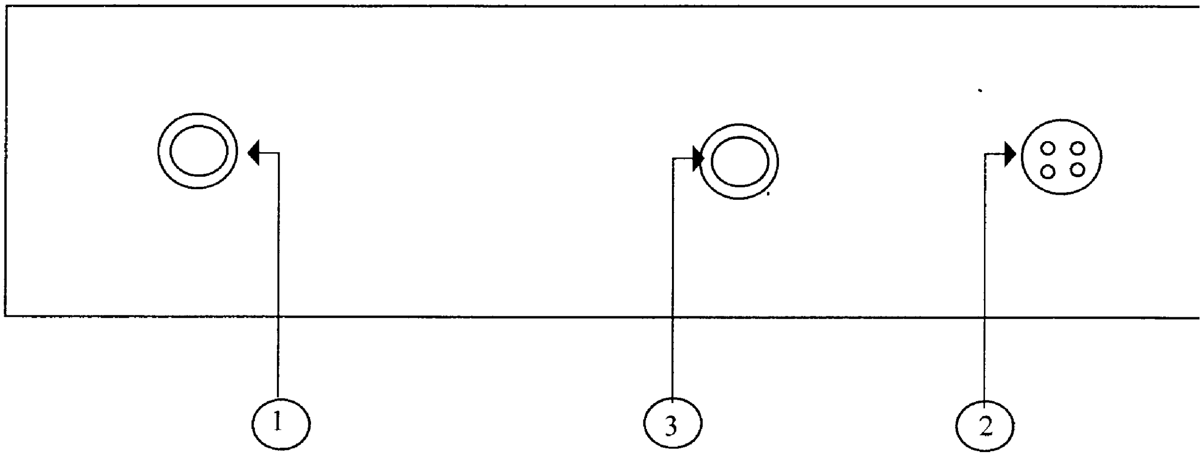
2 MAINS IEC CONNECTOR

The three pin plug of the mains lead must be pushed into this socket. This cannot b done incorrectly i.e with the live and neutral reversed because of the orientation o the unused earth pin.

3 FUSES

The mains transformer is protected by two in-line fuses, one on the live line an one on the neutral line. These fuses are located to the right hand side of the main on/off switch. The fuses are 20mm Anti Surge 2 amp to BS4265 for a machin supplied to the U.S. for the U.K. or Europe the fuses are 20 mm Anti Surge 1 am to BS 4265.

4.6 Front Panel Connection



1 LEFT HAND 4MM SOCKET

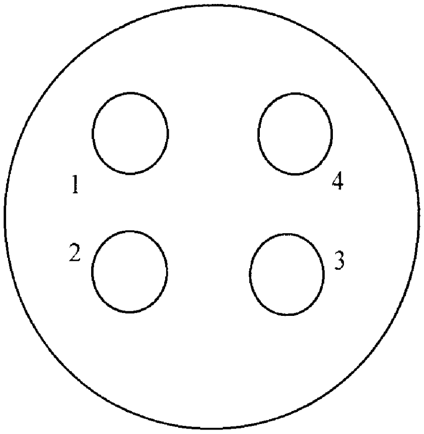
This socket is for the lead of the Dispersive Patient Pate, which should be of at leas 100 square centimetres, (10 square inches).

2 RIGHT HAND 4 WAY LEMO SOCKET

This socket is for the connection of the probe to the lesion generator and fo carrying the thermocouple signal.

3 CENTRAL 4 MM SOCKET

This socket is to connect the Test Block with which an audio indication of th presence of stimulation pulses can be obtained.



CONNECTOR PIN	
1	Screen
2	R.F.
3	Thermocouple +
4	Thermocouple -

5.0 DETAILED DESCRIPTION OF MODULES

5.1 Power Supply Unit (2800808001C)

Mains power is connected into the rear of the equipment and goes via two fuses to double pole ON/OFF switch. See Figure 5.1. The output of the switch is connecte to the main power Isolating Transformer TR101.

The Isolating Transformer is of a double bobbin type and has four secondar windings namely:-

Winding 1	30V	1 amp
Winding 2	15V	1 amp
Winding 3	15V	1 amp
Winding 4	12V	1 amp

All Windings go directly to the Power supply Card (2800808001C).

The Power Supply Card provides the following supplies:-

a) Approximately 40V DC for the RF Lesioning Power. The supply is used by the RF Generator Board (2800808004);

b) +12V DC Regulated Supply for all boards;

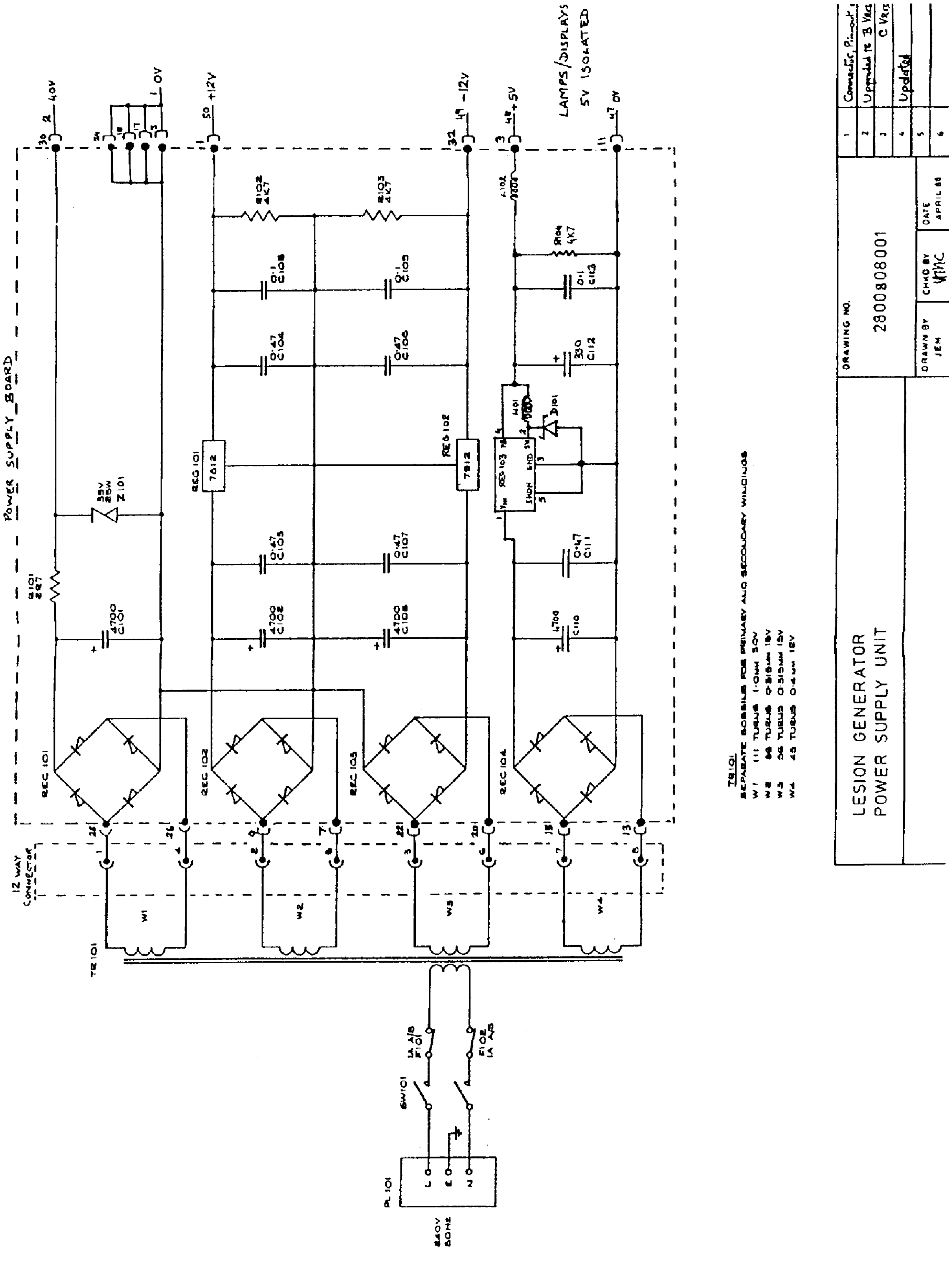
c) -12V DC Regulated Supply for the following Boards:-

   Stimulate Board (2800808003)
   Voltage and Current Metering Board (2800808005)
   Temperature Board (2800808006)

d) 5V DC Regulated Supply for Indicator lamps on the front panel an Digital Displays.

All four supplies are fused on the Fuse Board with 1 amp T Type Antisurge fuses.

Figure 5.1 Power Supply Unit - Circuit Diagram


40V
0V
+12V
-12V
+5V
0V
LAMPS/DISPLAYS
5V ISOLATED
POWER SUPPLY BOARD
R102 4K7
R103 4K7
R104 4K7
C103 0.1
C105 0.1
C113 0.1
C104 0.47
C106 0.47
C112 330
C105 0.47
C107 0.47
C111 0.47
C101 4700
C102 4700
C108 4700
C110 4700
R101 8R7
Z101 35V 5W
REG101 7812
REG102 7912
REG103
L101
D101
REC101
REC102
REC103
REC104
12 WAY CONNECTOR
W1
W2
W3
W4
TR101
SW101
F101 1A A/S
F102 1A A/S
PL101
L
E
N
240V 50HZ
TR101
SEPARATE BOBBINS FOR PRIMARY AND SECONDARY WINDINGS
W1 111 TURNS 1·0MM 30V
W2 56 TURNS 0·315MM 15V
W3 56 TURNS 0·315MM 15V
W4 45 TURNS 0·4MM 12V
LESION GENERATOR
POWER SUPPLY UNIT
DRAWING NO. 2800808001
DRAWN BY JEM
CHKD BY
DATE APRIL 88
1 Connector Pin-out
2 Upgraded to B Vrcs
3 C Vrcs
4 Updated
5
6

5.2 Fuse Board (2800808001D)

Each of the supply lines 12V, 5V, -12V, 40V is independently fused. Supplies come from th Power supply Unit (2800808001C) and pass through the Fuse Board before going to the res of the machine.

5.3 Impedance Board (2800808002)

Biological Impedance is measured using an AC Signal, by driving a constant lo value current through the unknown patient impedance and measuring the voltag developed.

A block diagram of the measuring system is shown in Figure 5.2 and th Impedance Board Circuit is shown in Figure 5.3.

Referring to the circuit diagram, Timer TM201 generates a square wave outpu whose frequency is set by P201. This frequency is set to approximately 53KH and the output from Pin 3 of TM201 is a 5V peak to peak waveform. Thi waveform is modified by Inductor L201 and capacitors C206 and C207 to give constant voltage sine wave at resistor R206. Since R206 at 10K ohm i considerably larger than any patient impedance the current through R206 i essentially constant. This current flows through the isolation transformer (T201 and the patient. A voltage is therefore developed across the patient impedance an is amplified by Amplifier OPA 201, OPA 202 is an active filter which filters o noise and other spurious signals, the cleaned up signal is then amplified by OP 203 and then rectified and filtered by D202, D203 and C219 before being passed t the Digital Impedance Meter via series potentiometer P204.

The Digital Impedance Meter reads the voltage across resistor R221 (750 ohms and is set to a range of 2 volts. A reading of 1999 ohms (1.999 volts) reads 1999 o the display. Capacitor C220 is connected across the meter to smooth the impedanc reading.

Figure 5.2 **Block Diagram - Impedance Circuit**

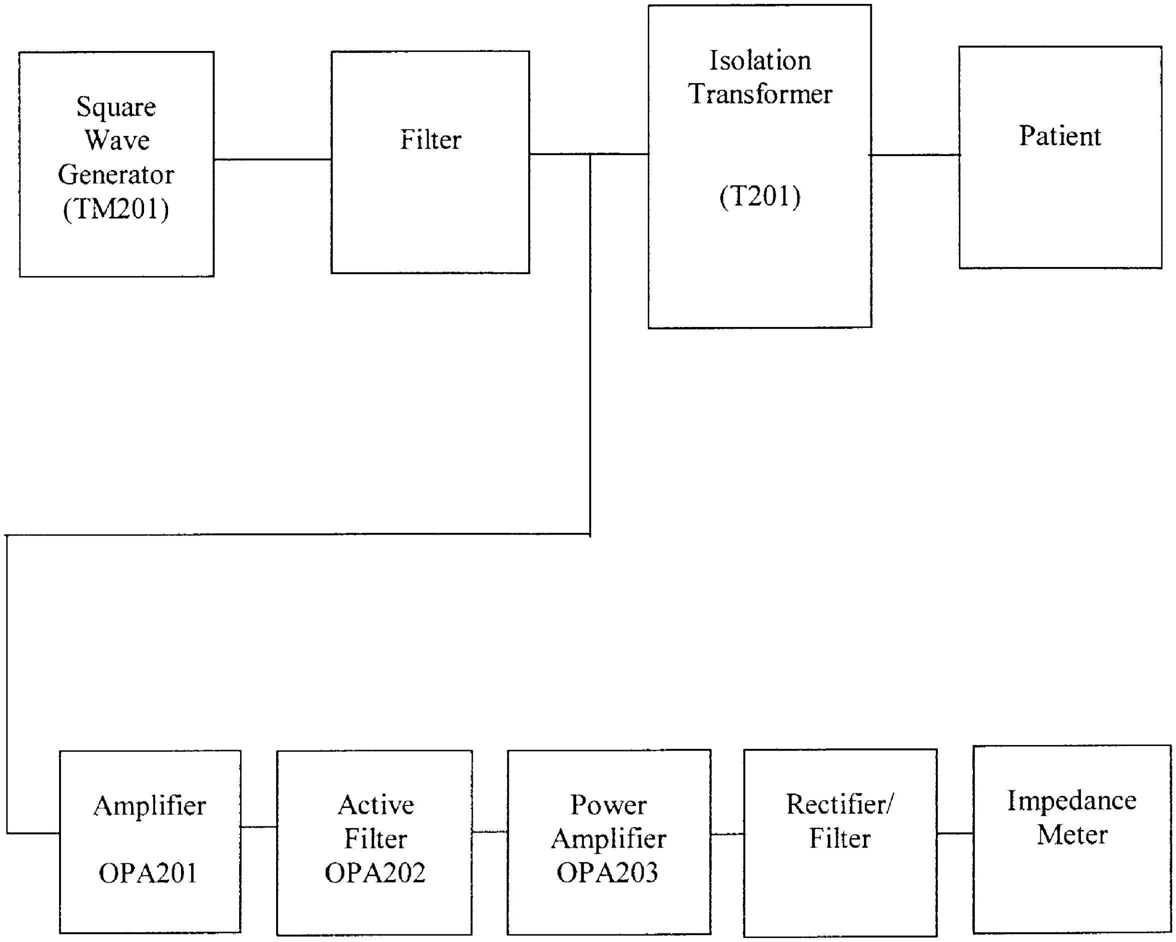
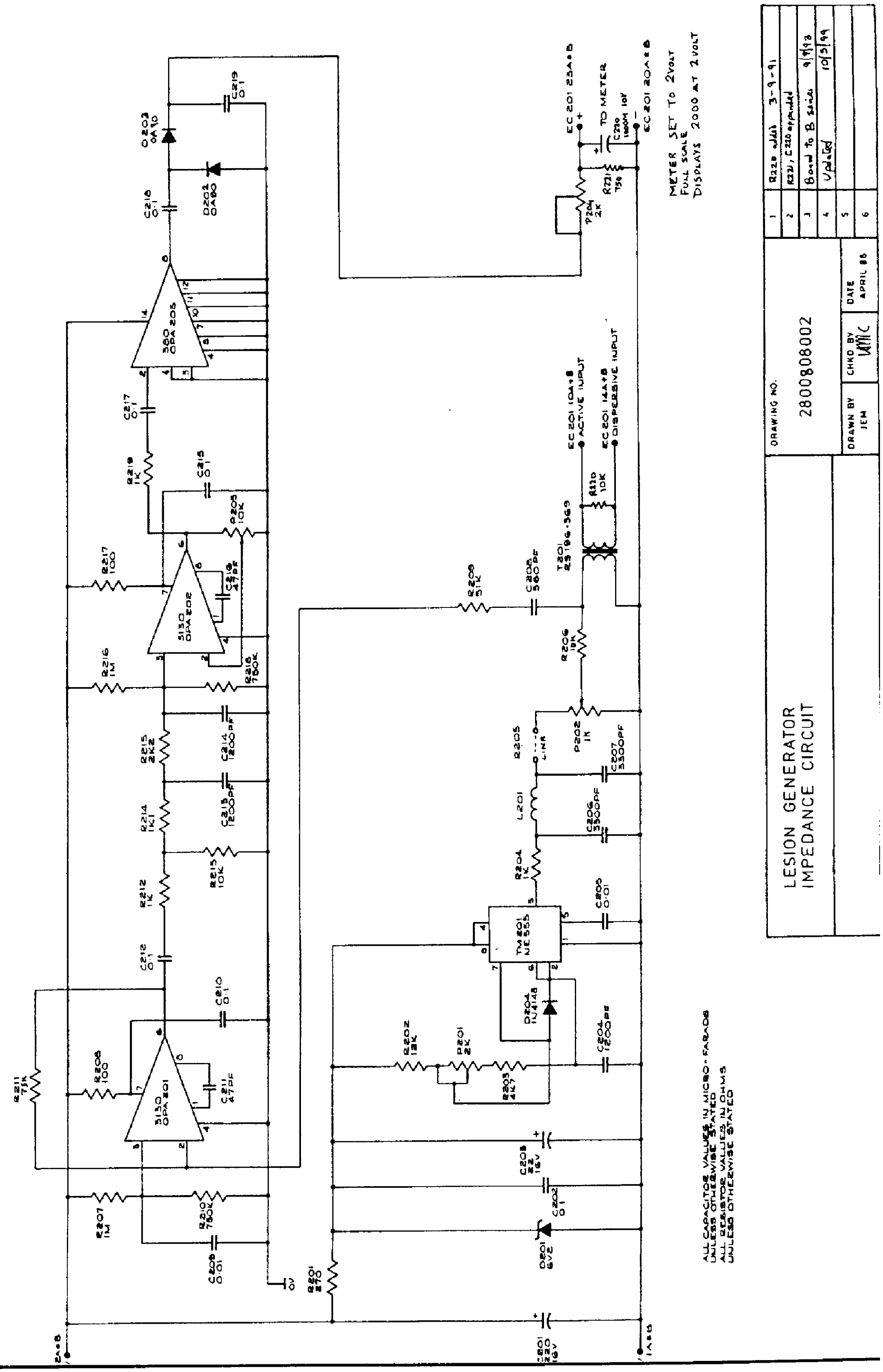

Square Wave Generator (TM201)
Filter
Isolation Transformer (T201)
Patient
Amplifier OPA201
Active Filter OPA202
Power Amplifier OPA203
Rectifier/ Filter
Impedance Meter

Figure 5.3 Impedance Board - Circuit Diagram


LESION GENERATOR
IMPEDANCE CIRCUIT
DRAWING NO.
2800808002
DRAWN BY
JEM
CHKD BY
DATE
APRIL 86
1 R220 added 3-9-91
2 R221, C220 expanded
3 Board to B series 9/9/93
4 Updated 10/5/99
5
6
EC201 23A+B
+
TO METER
C220 100M 10V
R221 750
P204 2K
EC201 20A+B
−
METER SET TO 2VOLT
FULL SCALE
DISPLAYS 2000 AT 2VOLT
EC201 10A+B
ACTIVE INPUT
EC201 14A+B
DISPERSIVE INPUT
R220 10K
T201 25196-369
C209 560PF
R209 51K
R206 10K
P202 1K
R205 LINK
C207 3300PF
C206 3300PF
L201
R204 1K
C205 0.01
IM201 NE555
D204 1N4148
C204 1200PF
R202 12K
P201 2K
R203 4K7
C203 22 16V
C202 0.1
D201 6V2
R201 270
C201 220 16V
1A+B
2A+B
D203 OA10
C219 0.1
D202 OA90
C218 0.1
380 OPA205
C217 0.1
R219 1K
C215 0.1
P205 10K
R217 100
5130 OPA202
C216 47PF
R216 1M
R218 750K
C214 1200PF
R215 2K2
C213 1200PF
R214 1K1
R215 10K
R212 1K
C212 0.1
C210 0.1
R211 75K
R208 100
5130 OPA201
C211 47PF
R207 1M
R210 750K
C208 0.01
ALL CAPACITOR VALUES IN MICRO-FARADS
UNLESS OTHERWISE STATED
ALL RESISTOR VALUES IN OHMS
UNLESS OTHERWISE STATED

5.4 Stimulate Board (2800808003)

When the Stimulate function is selected on the Lesion Generator the Stimulat Board is activated. The Circuit of the Stimulate Board is shown in Figure 5.4.

Referring to Figure 5.4, Timer TM301A produces a square wave output whos frequency is set by either resistors R301A and R301B for 100Hz pulse rate o resistors R302A and R302B for 3Hz pulse rate, which set of resistors are active i set by the Rate Switch (mounted on the front panel).

The output (Pin 5) from TM301A is fed to integrator Z301A and timer TM301B.

Z301A and Z301B convert the pulse train from a single sided pulse to a biphasi pulse as shown in Figure 5.5. P301 is used to set the balance between the upwar and downward sections of the waveform. C309 is used to produce a flat top to th biphasic waveforms and Resistance P302 is used to set the maximum biphasi voltage.

Timer TM301B converts the 3mS pulse width on its input to 60mS on its output t give reasonable length flashes on the Stimulate Rate LED mounted on the fron panel.

A typical stimulate waveform is shown in Figure 5.5. The actual peak to peak waveform is approximately twice the indication on the front panel Stimulate leve Digital Display Meter. The actual maximum available stimulate pulse height wil vary slightly with patient impedance. The exact relationship is shown on Figur 4.2.

The Stimulate Board also contains interlock relays and controls for setting up th Digital Display Meter.

The potentiometer (RV2) mounted on the front panel has two windings and a integral ON/OFF switch. One winding sets the stimulate output, and the othe winding provides a voltage to the Digital Display Meter. The meter is set for the 2 volt range. Full scale on the winding is set to 2 volts (adjusted by P303) and thi reads 2.00 on the display.

For stimulate output to be present, for the display to read , and for Stimulate Rat LED to flash Relays RLB1 and RLB2 need to be energised. This condition onl occurs if RLA at some point is de-energised. RLA can only be de-energised i potentiometer RV2 is turned fully anti-clockwise to open circuit, the ON/OF switch.

Once RLB1 and RLB2 are energised a contact of RLB1 holds them energise irrespective of whether RLA is energised or not.

If the active lead is connected to the Test Socket, and there is a stimulate signa greater than 1 mA, this signal is detected by transformer TF302 and amplified b Z302A and Z302B. Timer Z303 then provides a pulse to the sounder S301 whic gives an audio indication of the presence of a stimulate signal.

Figure 5.4 Stimulate Board - Circuit Diagram

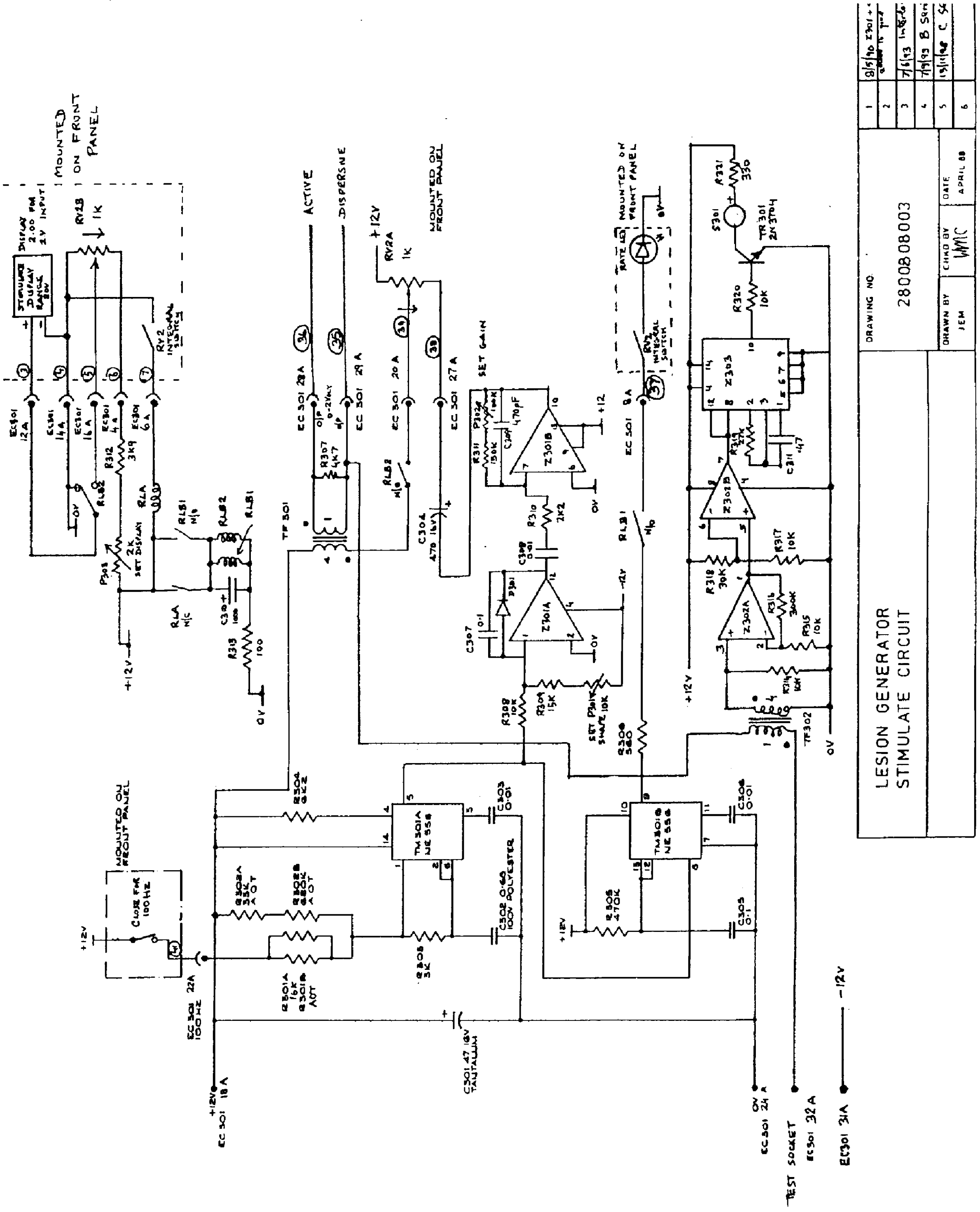
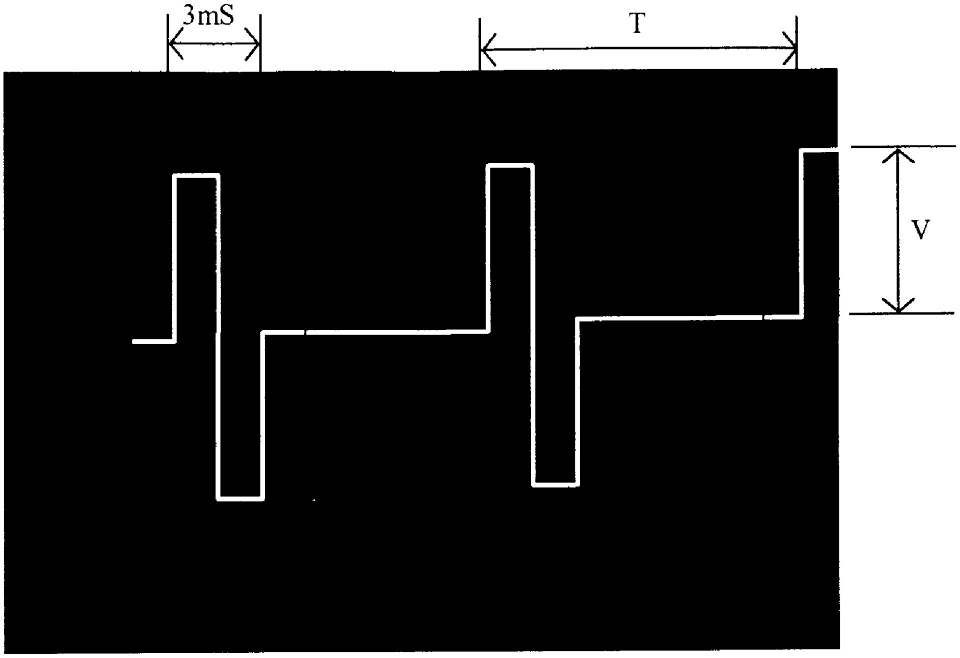

LESION GENERATOR
STIMULATE CIRCUIT
DRAWING NO
2800B08003
DRAWN BY JEM
CHKD BY
DATE APRIL 88
MOUNTED ON FRONT PANEL
STIMULATE DISPLAY
RV1B 1K
RV2 INTEGRAL SWITCH
P301 2K SET DISPLAY
R312 3K9
RLA
RLB1
RLB2
R313 100
TF301
ACTIVE
DISPERSIVE
R307 4K7
EC301 28A
EC301 29A
+12V
RV2A 1K
EC301 20A
EC301 27A
C304 470 1kV
SET GAIN
R311 150K
C309 470pF
Z301B
Z301A
R310 2K2
C308 0.01
D301
C307 0.1
R309 10K
R304 15K
SET P301 SHAPE 10K
RATE LED
R306 560
EC301 8A
Z303
R320 10K
TR301 2N3704
R321 330
S301
Z302B
Z302A
R318 30K
R317 10K
R316 300K
R315 10K
R314 10K
C311 47
TF302
+12V
0V
-12V
R304 6K2
C303 0.01
TM301A NE556
TM301B NE556
C306 0.01
R302A 33K AOT
R302B 680K AOT
R301A 16K
R301B AOT
R303 3K
C302 0.68 100V POLYESTER
R305 470K
C305 0.1
C301 47 16V TANTALUM
CLOSE FOR 100HZ
EC301 22A 100HZ
+12V EC301 18A
0V EC301 24A
TEST SOCKET EC301 32A
EC301 31A
−12V

Figure 5.5 **Typical Stimulate Waveform**



Waveform shown for 100 pulses/second

V = 0-2 Volts nominal

T = 10mS for 100 pulses/second

T = 333mS for 3 pulses/second

5.5 RF Generator Board (2800808004)

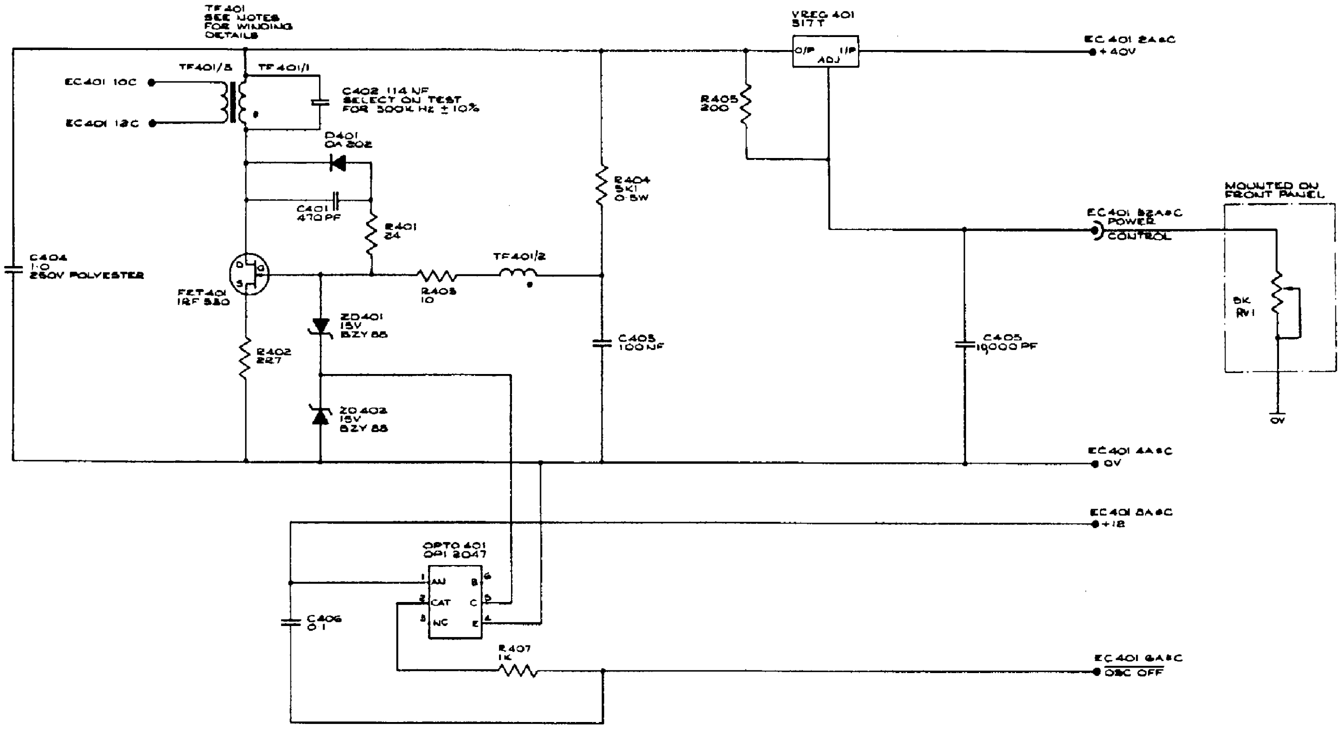
The RF Generator Board whose circuit diagram is shown in Figure 5.6 is essentiall a simple oscillator comprising FET401, Transformer TF401 and Capacitor C402 This oscillator has an oscillation frequency of approximately 300KHz. which is se by C402.

The oscillator circuit is powered from a DC voltage which can be varied from 1.2 to 40v by altering the offset adjustment of the variable voltage regulator VREG401 The offset adjustment is the Lesion Power control mounted on the front panel.

The output signal from the RF Board is an undistorted sine wave as shown in th Figure 5.7, whose shape is unaltered by changes in patient impedance.

In order to enable the RF power to be switched off if the maximum temperatur (measured at the lesion point) is exceeded, a simple opto isolated shut off circuit i incorporated on the board. This operates such that when the "OSC OFF" signa goes low, the opto isolator OPTO 401 is energised and Zener Diode ZD402 i shorted out effectively tying the gate of FET401 to a fixed voltage which inhibit the oscillations.

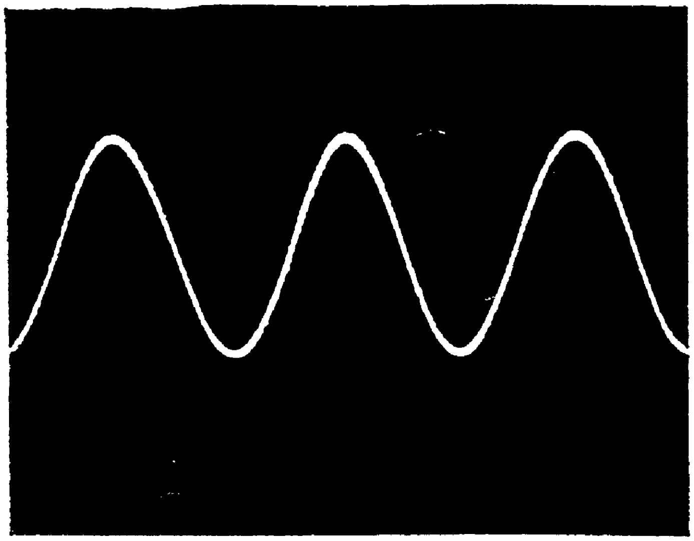
Figure 5.6 RF Generator - Circuit Diagram


TF401
SEE NOTES
FOR WINDING
DETAILS
TF401/3
TF401/1
EC401 10C
EC401 12C
C402 114 NF
SELECT ON TEST
FOR 300K Hz ± 10%
D401
OA 202
C401
470 PF
R401
24
C404
1·0
250V POLYESTER
FET401
IRF 530
D
G
S
R403
10
TF401/2
ZD401
15V
BZY 88
ZD402
15V
BZY 88
R402
2R7
R404
5K1
0·5W
C403
100NF
VREG 401
317T
O/P
I/P
ADJ
R405
200
EC401 2A&C
+40V
EC401 32A&C
POWER
CONTROL
C405
10000 PF
MOUNTED ON
FRONT PANEL
5K
RV1
0V
EC401 4A&C
0V
EC401 8A&C
+18
OPTO 401
OPI 2047
1
AN
2
CAT
3
NC
6
B
5
C
4
E
C406
0·1
R407
1K
EC401 6A&C
OSC OFF

NOTES
ALL RESISTORS 0·25W UNLESS OTHERWISE STATED
TRANSFORMER WINDING DETAILS
TF401/1 5 TURNS 1·0MM
TF401/2 1 TURN 1·0MM
TF401/3 6 TURNS 1·0MM
ALL CAPACITOR VALUES IN MICRO-FARADS
UNLESS OTHERWISE STATED

LESION GENERATOR RF GENERATOR CIRCUIT	DRAWING NO. 2800808004			1	Redrawn & Modified
				2	
				3	
				4	
	DRAWN BY JEH	CHKD BY HMC	DATE APRIL 88	5	
				6	

Figure 5.7 **Typical Lesioning Waveform**



Frequency 300KHZ

Max RMS Voltage 40V

5.6 RF Voltage and Current Metering Board (2800808005)

The Circuit Diagram of the RF Voltage and Current Metering Board is shown i Figure 5.8.

The Board has two basic functions, these are:-

a) to convert RF Current and Voltage to DC levels so they can be monitored by the DC Meters,

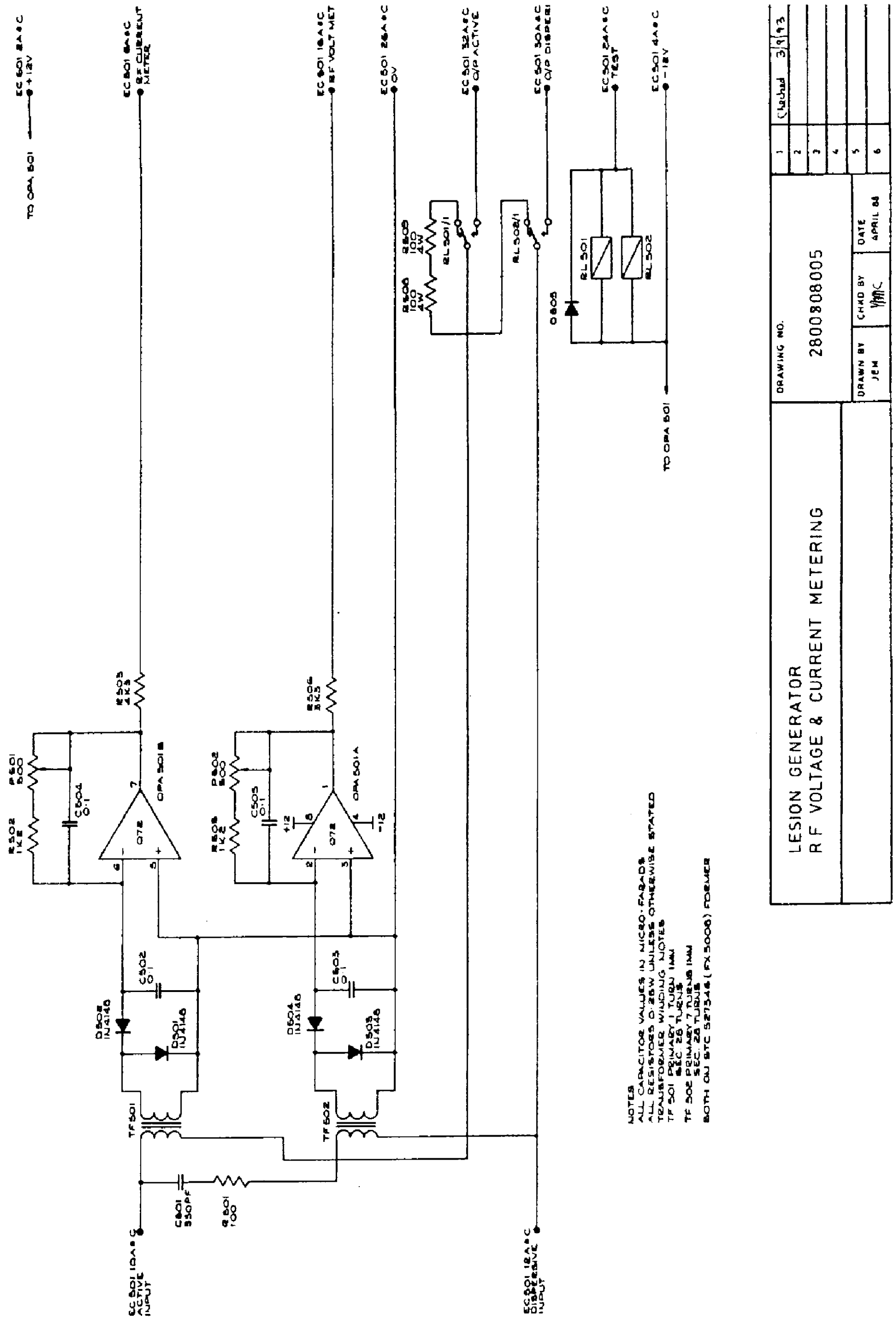
and

b) to provide a 200 ohm load under test conditions.

Relays RL501 and RL502 are normally de-energised, and the Active an Dispersive Signals from the RF Generator Board are internally connected across th 200 ohm load R508 and R509. When the Lesion Generator is in the “Lesion condition, 12 volt is applied to the board on Pins 24A and C, and the two relays ar activated allowing the RF Generator Board Signal to be connected to the patient.

Regarding the metering side of the circuit, the current transformer TF501 monitor the in-line current on the active line. 1/28 of it is rectified by D501 and D502, th DC output is amplified by a variable gain amplifier OPA 501B. The gain of th amplifier is set so that for 200mA current, the 1mA full scale meter reads 200mA In a similar way TF502 measures a proportion of the current flowing between th active and dispersive lines. The actual impedance between the two lines is in th order of 1600 ohms, made up of C501, R501 and TF502, so about 25mA flow through this impedance chain. 7/28 of this current is rectified by D503 and D50 and amplified by variable gain amplifier OPA 501A. The gain of the amplifier i set so that 40v between Active and Dispersive gives 1mA (40v) full scale on th RMS Voltmeter.

Figure 5.8 RF Voltage and Current Metering - Circuit Diagram


EC501 2A+C +12V
TO OPA 501
EC501 6A+C RF CURRENT METER
EC501 16A+C RF VOLT MET
EC501 26A+C 0V
EC501 32A+C O/P ACTIVE
EC501 30A+C O/P DISPERSE
EC501 24A+C TEST
EC501 4A+C -12V
TO OPA 501
R505 100 4W
R509 100 4W
RL501/1
RL502/1
D505
RL501
RL502
R503 2K2
R504 3K3
R501 500
R502 1K2
C504 0.1
OPA501B
072
R502 500
R508 1K2
C505 0.1
OPA501A
+12
-12
C502 0.1
C503 0.1
D502 1N4148
D501 1N4148
D504 1N4148
D503 1N4148
TF501
TF502
C501 330PF
R501 100
EC501 10A+C ACTIVE INPUT
EC501 12A+C DISPERSIVE INPUT
NOTES
ALL CAPACITOR VALUES IN MICRO-FARADS
ALL RESISTORS 0.25W UNLESS OTHERWISE STATED
TRANSFORMER WINDING NOTES
TF501 PRIMARY 1 TURN 1MM
SEC. 28 TURNS
TF502 PRIMARY 7 TURNS 1MM
SEC. 28 TURNS
BOTH ON STC 527546 (FX5008) FORMER
LESION GENERATOR
RF VOLTAGE & CURRENT METERING
DRAWING NO.
2800808005
DRAWN BY JEH
CHKD BY
DATE APRIL 84
Checked 3/9/93
1
2
3
4
5
6

5.7 Temperature Board (2800808006)

The temperature measuring section of the Lesion Generator is accommodated o the Temperature Board, the circuit of which is shown in Figure 5.9.

The external thermocouple (Type K - chromel-alumel) is connected to thermocouple amplifier with integral cold junction (Z601). The connection is via multipole low pass filter made up of R604, R605, R606, R607 and C604, C60 C606, C609, C610, C611, which has an attenuation of over 100dB at 300KH enabling temperature to be taken during the application of RF Voltages. Th amplifier provides both cold junction compensation and linearisation of th incoming signal as shown in Figure 5.10. The output from the amplifier approximately 10mV/°C.

Output from the thermocouple amplifier goes via amplifier Z 603 when an offs voltage of approximately 300mV is added (via Potentiometer P601) to cater for th temperature meter being scaled from 30°C. A gain control (Potentiometer) P602 also provided to set the 100°C point on the meter.

The output voltage from Z 603 also provides one of the inputs to comparator Z 60 The other input to the comparator is provided by a voltage from the resistor chai comprising R612, R613 and P603. With the temperature limit switch set to 90° P603 is set so that when the meter is reading approximately 90°C, the comparat output goes high, TR601 switches on and the EXCESS TEMPERATURE sign goes low. This signal is used to disable the RF Lesioning signal generated by th RF Generator Board.

Similarly P605 and P606 control the excess of 70°C and excess of 80°C settings.

Relay RL601 is energised in the RF Pulsed mode and P604 sets the 42°C limi Z604 provides the Pulse Mode envelope which is used to drive the Exce Temperature signal and hence allow the RF signal from the RF Generator Board t be provided in controlled bursts.

The Thermocouple Amplifier Z601 provided an output which indicates whether thermocouple is in circuit or whether a thermocouple is open circuit. This output used to drive relay RL602 which indicates via a Green/Red LED on the Fro Panel.

Figure 5.9 Temperature Board - Circuit Diagram

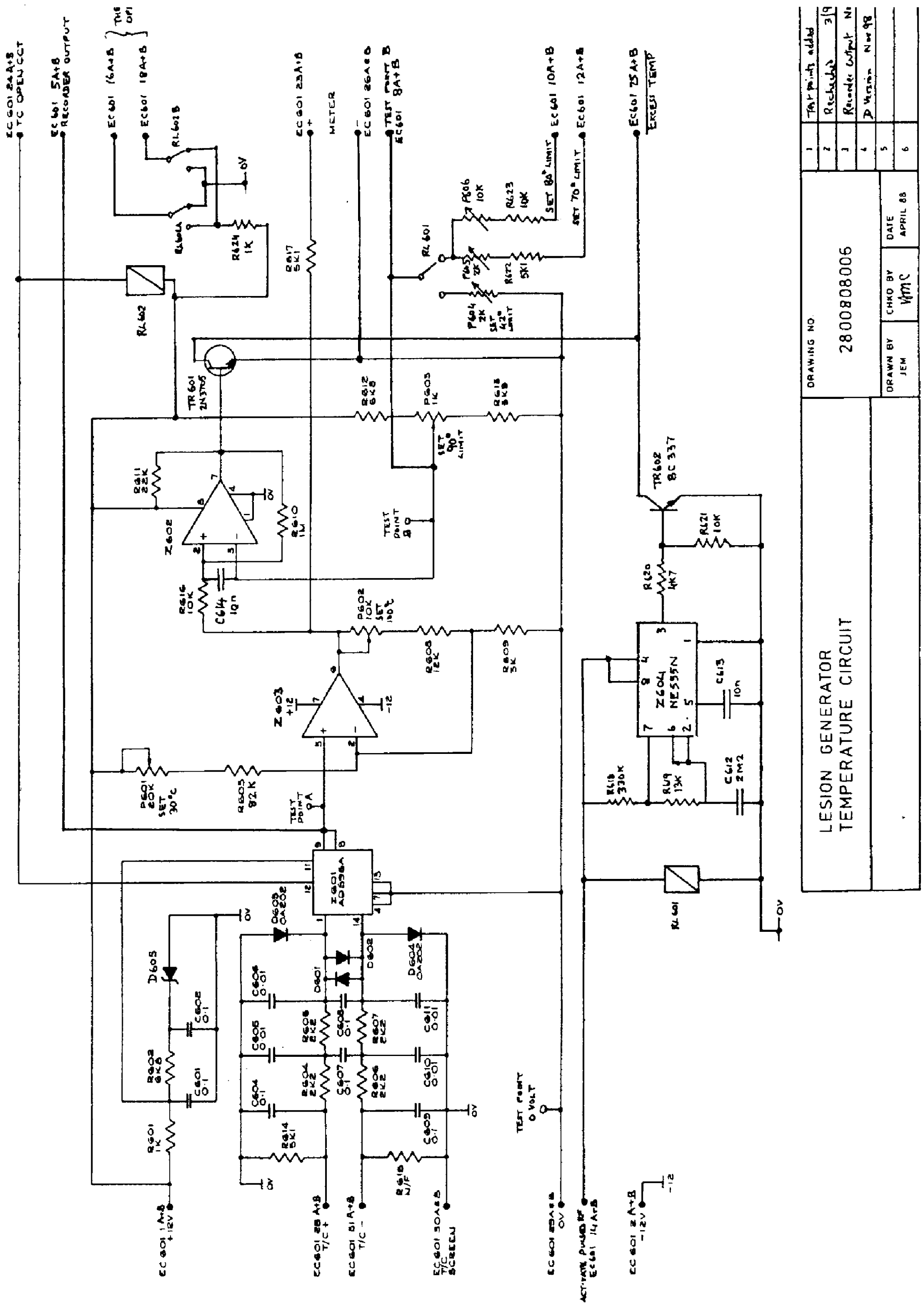

LESION GENERATOR
TEMPERATURE CIRCUIT
DRAWING NO
2800808006
DRAWN BY JEM
CHKD BY
DATE APRIL 88
Z601 AD595A
Z602
Z603
Z604 NE555N
TR601 2N3705
TR602 BC337
RL601
RL602
RL601A
RL601B
D601
D602
D603 OA202
D604 OA202
D605
P601 20K SET 30°C
P602 10K SET 100°
P603 1K SET 90° LIMIT
P604 2K SET 42° LIMIT
P605 2K
P606 10K
R601 1K
R602 6K8
R603 82K
R604 2K2
R605 2K2
R606 2K2
R607 2K2
R608 12K
R609 3K
R610 1M
R611 22K
R612 6K8
R613 6K8
R614 5K1
R615 N/F
R616 10K
R617 5K1
R618 330K
R619 13K
R620 4K7
R621 10K
R622 5K1
R623 10K
R624 1K
C601 0.1
C602 0.1
C604 0.1
C605 0.01
C606 0.01
C607 0.1
C608 0.1
C609 0.1
C610 0.01
C611 0.01
C612 2M2
C613 10n
C614 10n
EC601 24A+B TC OPEN CCT
EC601 5A+B RECORDER OUTPUT
EC601 16A+B
EC601 18A+B
TO OPI
EC601 23A+B +
METER
EC601 26A+B −
TEST POINT B
EC601 8A+B
EC601 10A+B SET 80° LIMIT
EC601 12A+B SET 70° LIMIT
EC601 15A+B EXCESS TEMP
TEST POINT A
TEST POINT 0 VOLT
EC601 1A+B +12V
EC601 28A+B T/C +
EC601 31A+B T/C −
EC601 30A+B T/C SCREEN
EC601 25A+B 0V
ACTIVATE POWER RF EC601 14A+B
EC601 2A+B −12V
0V
+12
−12
Test point added
Recorder output

Figure 5.10 Relationship between Thermocouple Input and Amplifier Output Signals

Thermocouple Temperature °C	Thermocouple Voltage mV	Output Voltage from AD 595 in mV
0	0	2.7
10	0.397	101
20	0.798	200
30	1.203	300
40	1.611	401
50	2.022	503
60	2.436	605
70	2.851	707
80	3.266	810
90	3.681	912
100	4.095	1015

5.8 Timer and Interlock Board (2800808007)

The Timer and Interlock Board is shown in Figure 5.11.

The Board contains two main sections which relate to:

a) One second timing
b) Machine interlocks

The one second timing pulses are generated by the Programmable Timer Z702, the one second period being set by potentiometer RV701. Output from Z702 is buffered by transistor T701 and drives the Tick relay on the Counter Interface Board.

The Timer is disabled if the Lesion Power Control is off or if the counter registers zero energising RLE. Both these conditions put an 'H' on Z703 Pin 13.

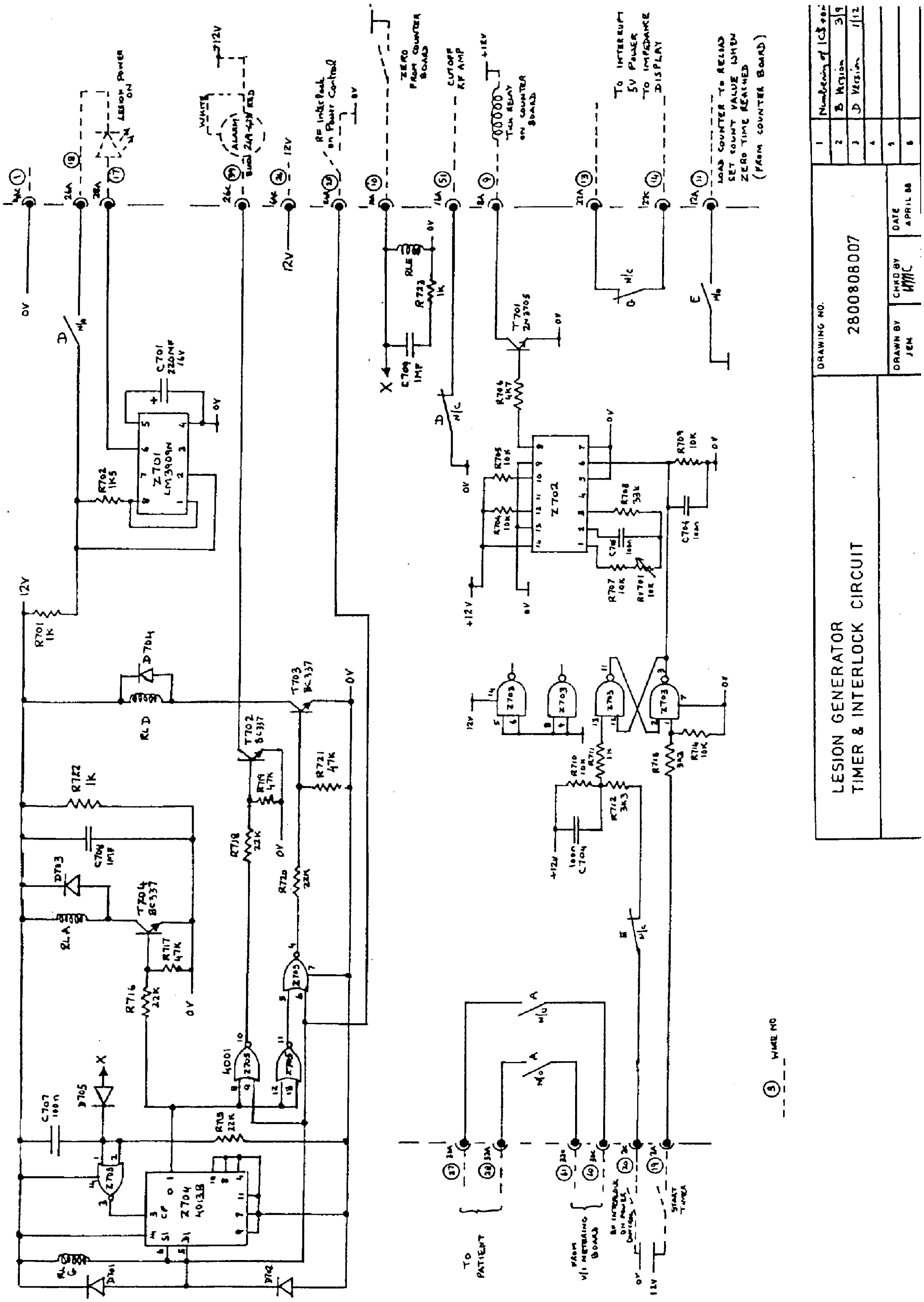
The Interlock part of the circuit consists of Relays A,D,G and Integrated Circuits Z704 ar Z705. RF Active and Dispersive lines from the RF Generator Board and Metering Boai come into the Interlock Board on Pins 30C (Active) and 32C (Dispersive). When Relay A activated, these signals are connected to Pins 30A and 32A which connects through to tl Active and Dispersive Sockets on the Lesion Generator. The Interlock circuit is controlle by the switch on the Lesion Power Potentiometer which is open when the potentiometer is the off position.

When the Lesioning Function is selected on the main Function Switch + 12 volts is provide to the Board, and when Relay G is in an energised state - the power potentiometer is not its off position - this condition disables Relay A and sounds the alarm.

Once the Lesion Power Potentiometer is switched off Z 704 causes the Alarm to switch o Relay A then become energised allowing signal through to the external sockets of tl Lesion Generator. Relay D is also energised enabling the signal from the LED Flasher Z7C to flash the Lesion Power Lamp. Relay G switches off the impedance display if the Lesic Power Potentiometer is away from its OFF position. This situation occurs when the ma Function Switch is in the Test position.

Relay RLD is also used to disable the RF output of the Generator. RLD needs to be energised for the machine to give power to the patient.

Figure 5.11 Timer and Interlock Board - Circuit Diagram


LESION GENERATOR
TIMER & INTERLOCK CIRCUIT
DRAWING NO. 2800808007
DRAWN BY JEN
CHKD BY
DATE APRIL 88
Z701 LM3909N
Z702
Z704 4013B
Z703
Z705 4001
T701 2N3705
T702 BC337
T703 BC337
T704 BC337
RLA
RLD
RLE
RLG
D701
D702
D703
D704
D705
C701 220MF 16V
C707 100n
C709 1MF
R701 1K
R702 1K5
R716 22K
R717 47K
R718 22K
R719 47K
R720 22K
R721 47K
R722 1K
R723 1K
12V
+12V
0V
TO PATIENT
FROM V/I METERING BOARD
START TIMER
TO INTERRUPT 5V POWER TO IMPEDANCE DISPLAY
LOAD COUNTER TO RELOAD SET COUNT VALUE WHEN ZERO TIME REACHED (FROM COUNTER BOARD)
ZERO FROM COUNTER BOARD
CUTOFF RF AMP
TIC RELAY ON COUNTER BOARD
LESION POWER ON
ALARM
WIRE NO

5.9 Counter Interface Board (2800808008)

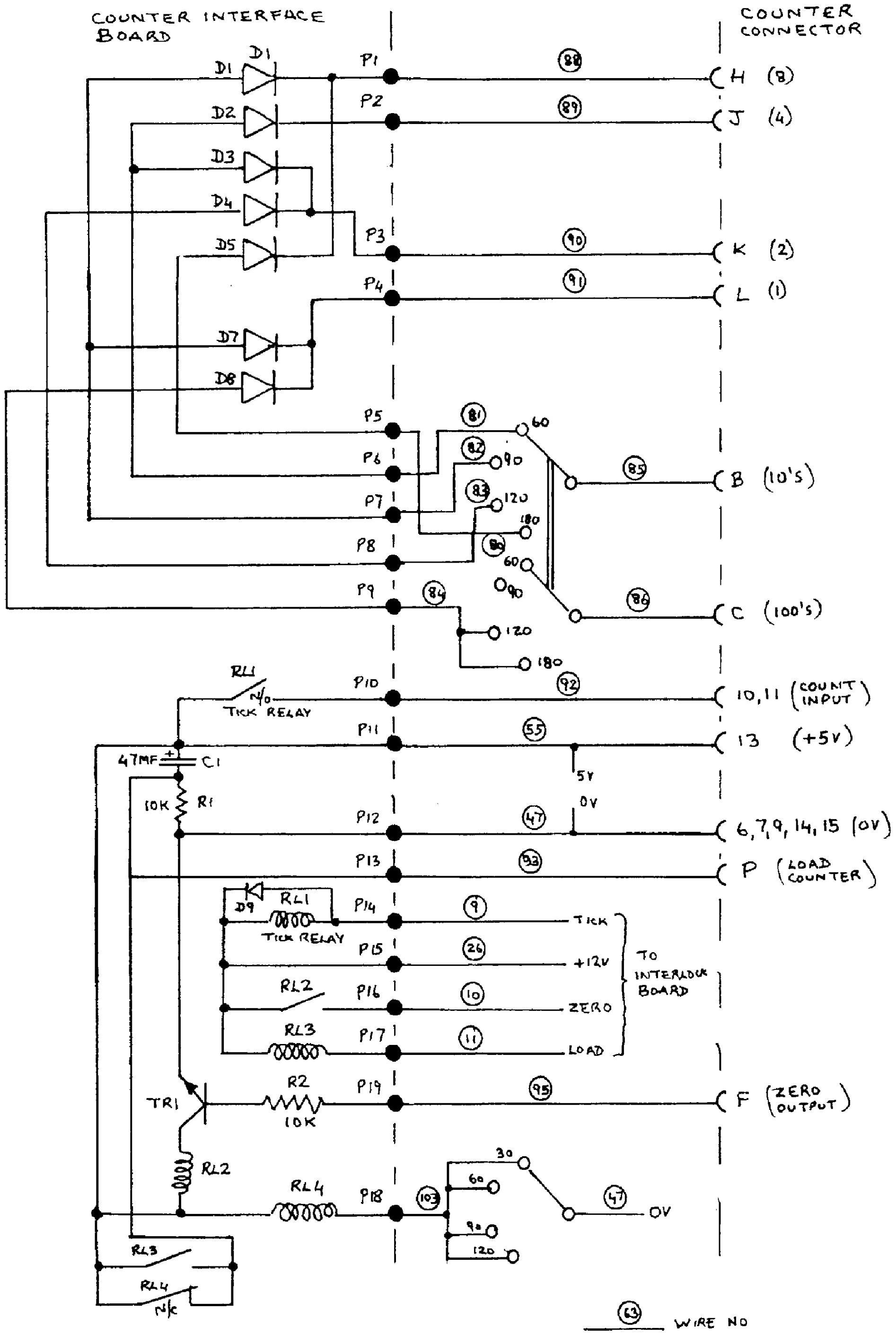
The Counter Interface Board is located in the Digital Timer and provides the interfacing of signals from the Timer and Interlock Board, Timer Selector Switch and Digital Counter.

The circuit diagram of the Board is shown in Figure 5.12.

The Timer Selector Switch has three Banks, two banks are used to select the preset times fo Lesioning, selection is made via diodes. The third bank de-energises RL4 during switching from one selection position to another, this causes the Load Count input of the counter to go to 5v for a short period and loads the preselected counts into the Digital Counter. When the clock on the Timer and Interlock Board is enabled, one second pulses are sent to the Counte Interface Board. These pulses cause RL1 to switch ON and OFF (to give an audible 'Tick') and RL1 contact to provide a count down pulse onto the Digital Counter.

The Digital Counter counts down to zero, and on zero energises Relay RL2. This provides pulse to the Timer and Interlock Board briefly energising relay RLE. The contacts of RL1 are used to energise RL3 on the Counter Interface Board and provide a Load pulse to th counter to reset the count to the preset value selected by the Timer Selector Switch.

Figure 5.12 Counter Interface Board - Circuit Diagram


COUNTER INTERFACE BOARD
COUNTER CONNECTOR
D1
D2
D3
D4
D5
D7
D8
P1
P2
P3
P4
P5
P6
P7
P8
P9
P10
P11
P12
P13
P14
P15
P16
P17
P19
P18
88
89
90
91
81
82
83
80
84
85
86
92
55
47
93
9
26
10
11
95
103
47
H (8)
J (4)
K (2)
L (1)
B (10's)
C (100's)
10,11 (COUNT INPUT)
13 (+5V)
6,7,9,14,15 (0V)
P (LOAD COUNTER)
F (ZERO OUTPUT)
60
90
120
180
60
90
120
180
5V
0V
RL1
N/O
TICK RELAY
47MF
C1
10K
R1
D9
RL1
TICK RELAY
RL2
RL3
TICK
+12V
ZERO
LOAD
TO INTERLOCK BOARD
TR1
R2
10K
RL2
RL4
30
60
90
120
0V
RL3
RL4
N/C
63
WIRE NO

COUNTER INTERFACE BOARD 2800808008

7-1-94
UPDATED 10-5-99

5.10 System Layout and Wiring (2800809001)

The Wiring of the Lesion Generator is shown in Figure 5.13.

The seven boards which make up the individual functions of the machine ar mounted in a card rack which is accessible by removing the rear panel.

The main function switch SW1, provides power to the various boards whe particular functions are selected as detailed in Figure 5.14.

The various Meters and Displays on the machine are illuminated when particul functions that relate to them are selected.

The Counter Interface Board is located in the Digital Counter which display Lesion Time.

The various Digital Meters are powered by a 5 volt supply. the 0 volts for th supply is floating in relation to the 0 volts for the +12,-12,+40 volt supplies.

Figure 5.13 System Wiring - Circuit Diagram

Only available on request

Figure 5.14 Voltages on Circuit Boards related to position of Main Function Switch

	FUNCTION SWITCH				
	Off	Test	Impedance	Stimulate	Lesion
Impedance		+12V	+12V		
Stimulate				+12V -12V	
RF Generator.		40V +12V			40V +12V
V/I Metering		+12V -12V			+12V -12V
Temp.		+12V -12V			+12V -12V
Timer/Interlock		+12V			+12V
Meters/Lamps/ Displays					
Temperature		X			X
RF Volts		X			X
RF Milliamps		X			X
Impedance		X	X		
Timer		X			X
Stimulate				X	

6.0 CIRCUIT DIAGRAMS AND PARTS LISTS

This section contains details of all circuit boards, and general wiring:-

a) Parts Lists

b) Circuits

c) Board Layouts

Details are included for the following Boards:-

a) Power Supply Unit Board	No. 2800808001C
b) Fuse Board	No. 2800808001D
c) Impedance Board	No. 2800808002
d) Stimulate Board	No. 2800808003
e) RF Generator Board	No. 2800808004
f) RF Voltage and Current Metering Board	No. 2800808005
g) Temperature Board	No. 2800808006
h) Timer and Interlock Board	No. 2800808007
i) Counter Interface Board	No. 2800808008
j) System Schematic - Interwiring	No. 2800809001

6.1 Power Supply Unit Board – 2800808001C

Components:-

R101	2R7	2.5W	5% Wirewound
R102	4K7	¼W	5% Carbon Film
R103	4K7	¼W	5% Carbon Film
R104	4K7	¼W	5% Carbon Film
C101	4700MF	63V	Electrolytic
C102	4700MF	25V	Electrolytic
C103	470nF	63V	Polyester
C104	470nF	63V	Polyester
C105	100nF	63V	Polyester
C106	4700MF	25V	Electrolytic
C107	470nF	63V	Polyester
C108	470nF	63V	Polyester
C109	100nF	63V	Polyester
C110	4700MF	25V	Electrolytic
C111	470nF	63V	Polyester
C112	330 MF	16V	Electrolytic
C113	100nF	63V	Polyester
Z101	BZY 93C 39R		39V Zener 25W (on Heat Sink)
REG 101	7812	12V Regulator on Heat Sink	
REG 102	7912	-12V Regulator on Heat Sink	
REG 103	MIC 4576	5V Regulator on Heat Sink	
REC 101	KBPC 602		6A Bridge Rectifier
REC 102	KBPC 602		6A Bridge Rectifier
REC 103	KBPC 602		6A Bridge Rectifier
REC 104	KBPC 602		6A Bridge Rectifier
D101	Schottky Diode		IN5821RL
L101	Inductor 40μH		
L102	Inductor 40μH		
EC101	32 way connector DIN 41612 Type B		
	Handle Black		

Figure 6.1 Power Supply Board - 2800808001B - Circuit Diagram

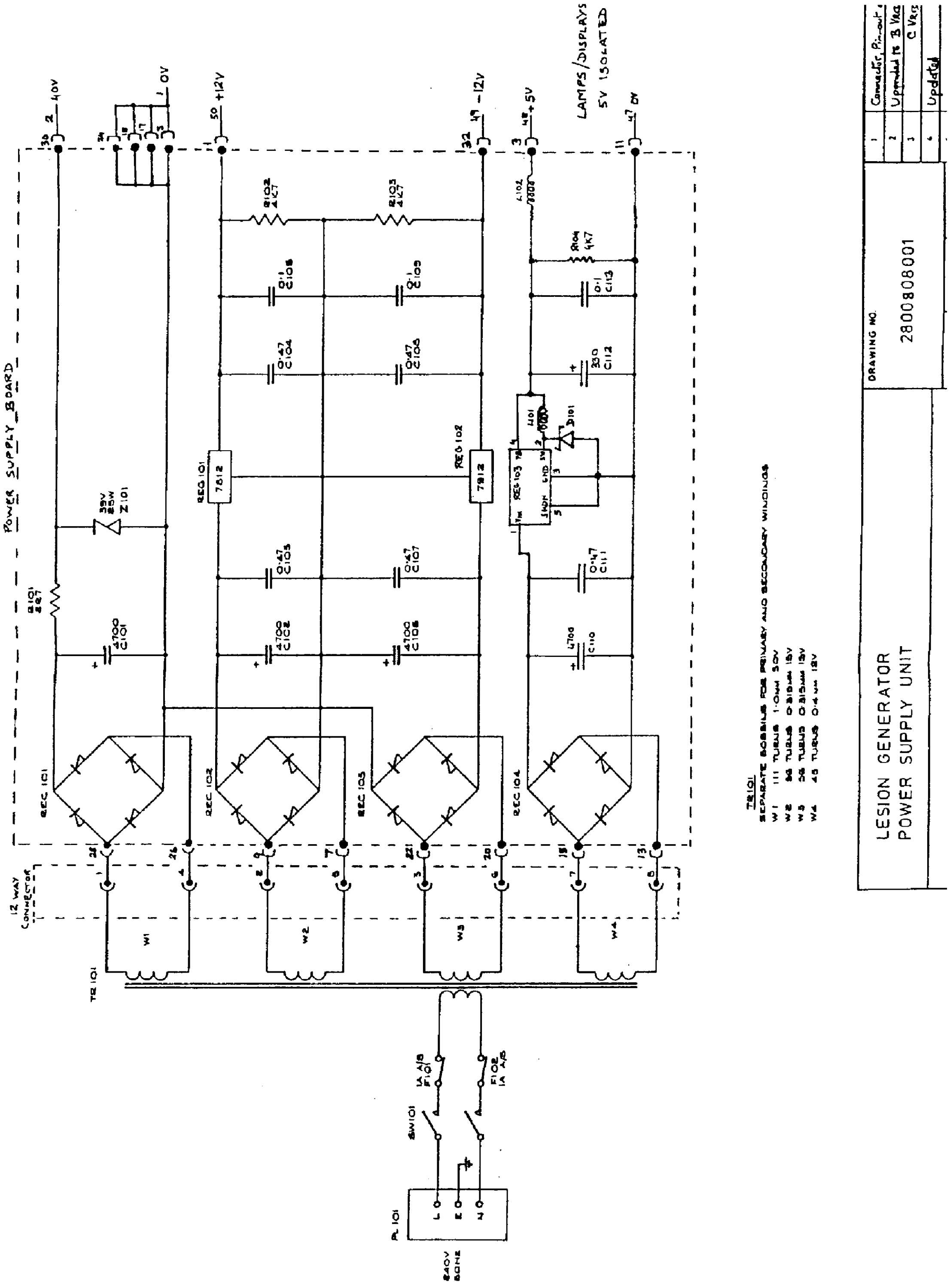
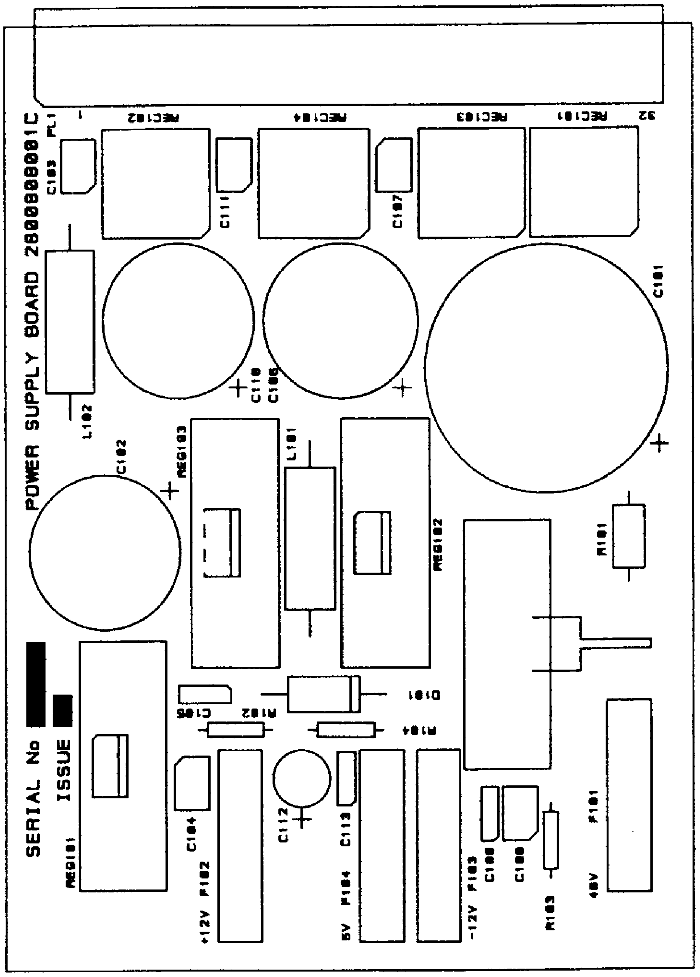

40V
0V
+12V
-12V
+5V
0V
LAMPS/DISPLAYS
5V ISOLATED
POWER SUPPLY BOARD
R101 3R7
C101 4700
Z101 39V 5W
R102 4K7
R103 4K7
C108 0.1
C109 0.1
C104 0.47
C106 0.47
REG 101 7812
REG 102 7912
C105 0.47
C107 0.47
C102 4700
C103 4700
REC 101
REC 102
REC 103
REC 104
L102
R104 4K7
C113 0.1
C112 330
L101
D101
REG 103
C111 0.47
C110 4700
12 WAY CONNECTOR
W1
W2
W3
W4
TR101
SW101
F101 1A A/S
F102 1A A/S
PL101
L
E
N
240V 50Hz
TR101
SEPARATE BOBBINS FOR PRIMARY AND SECONDARY WINDINGS
W1 111 TURNS 1.0mm 30V
W2 56 TURNS 0.315mm 18V
W3 56 TURNS 0.315mm 18V
W4 45 TURNS 0.4mm 12V
LESION GENERATOR
POWER SUPPLY UNIT
DRAWING NO
2800808001
1 Connector Pin-out
2 Upgraded to B Vers
3 C Vers
4 Updated

Figure 6.2 Power Supply Board - 2800808001 - Component Layout


POWER SUPPLY BOARD 2800808001C
PL1
1
32
REC102
REC104
REC103
REC101
C103
C111
C107
C101
L102
C110
C109
C102
REG103
L101
REG102
R101
D101
C105
R102
R104
SERIAL No
ISSUE
REG101
C104
+12V F102
C112
C113
5V F104
-12V F103
C108
C106
R103
48V F101

6.2 Impedance Board - 2800808002B

Components

R201	270	¼W 5% Carbon Film
R202	12K	¼W 5% Carbon Film
R203	4K7	¼W 5% Carbon Film
R204	1K	¼W 5% Carbon Film
R205	Link	
R206	10K	¼W 5% Carbon Film
R207	1M	¼W 5% Carbon Film
R208	100	¼W 5% Carbon Film
R209	51K	¼W 5% Carbon Film
R210	750K	¼W 5% Carbon Film
R211	75K	¼W 5% Carbon Film
R212	1K	¼W 5% Carbon Film
R213	10K	¼W 5% Carbon Film
R214	1K1	¼W 5% Carbon Film
R215	2K2	¼W 5% Carbon Film
R216	1M	¼W 5% Carbon Film
R217	100	¼W 5% Carbon Film
R218	750K	¼W 5% Carbon Film
R219	1K	¼W 5% Carbon Film
R220	10K	¼W 5% Carbon Film
R221	750	¼W 5% Carbon Film
P201	2K	25 turn Trimmer Type 94P
P202	1K	25 turn Trimmer Type 94P
P203	10K	25 turn Trimmer Type 94P
P204	2K	25 turn Trimmer Type 94P
C201	220MF	16V Electrolytic
C202	100nF	63V Polyester
C203	22MF	16V Electrolytic
C204	1200pF	160V Polystyrene
C205	10nF	100V Polyester
C206	3300pF	160V Polystyrene
C207	3300pF	160V Polystyrene
C208 A + B	390pF	Silver Mica
C209	10nF	100V Polyester
C210	100nF	63V Polyester
C211	47pF	Silver Mica
C212	100nF	63V Polyester
C213	1200pF	160V Polystyrene

6.2 Impedance Board - 2800808002B (continued)

Components
(continued)

C214	1200pF	160V Polystyrene
C215	100nF	63V Polyester
C216	47pF	Silver Mica
C217	100nF	63V Polyester
C218	100nF	63V Polyester
C219	100nF	63V Polyester
C220	1000MF	10V Electrolytic
D201	6V2	Zener Diode
D202	OA90	Diode
D203	OA90	Diode
D204	IN4148	Diode
OPA 201	CA3130E	
OPA 202	CA3130E	
OPA 203	LM380N	
TM201	NE555N	Timer
T201	Type PT4	Pulse Transformer
L201	10µH	Inductor
EC 201	64 way connector DIN 41612 Type B	
White Handle		

Figure 6.3 Impedance Board - 2800808002B - Circuit Diagram

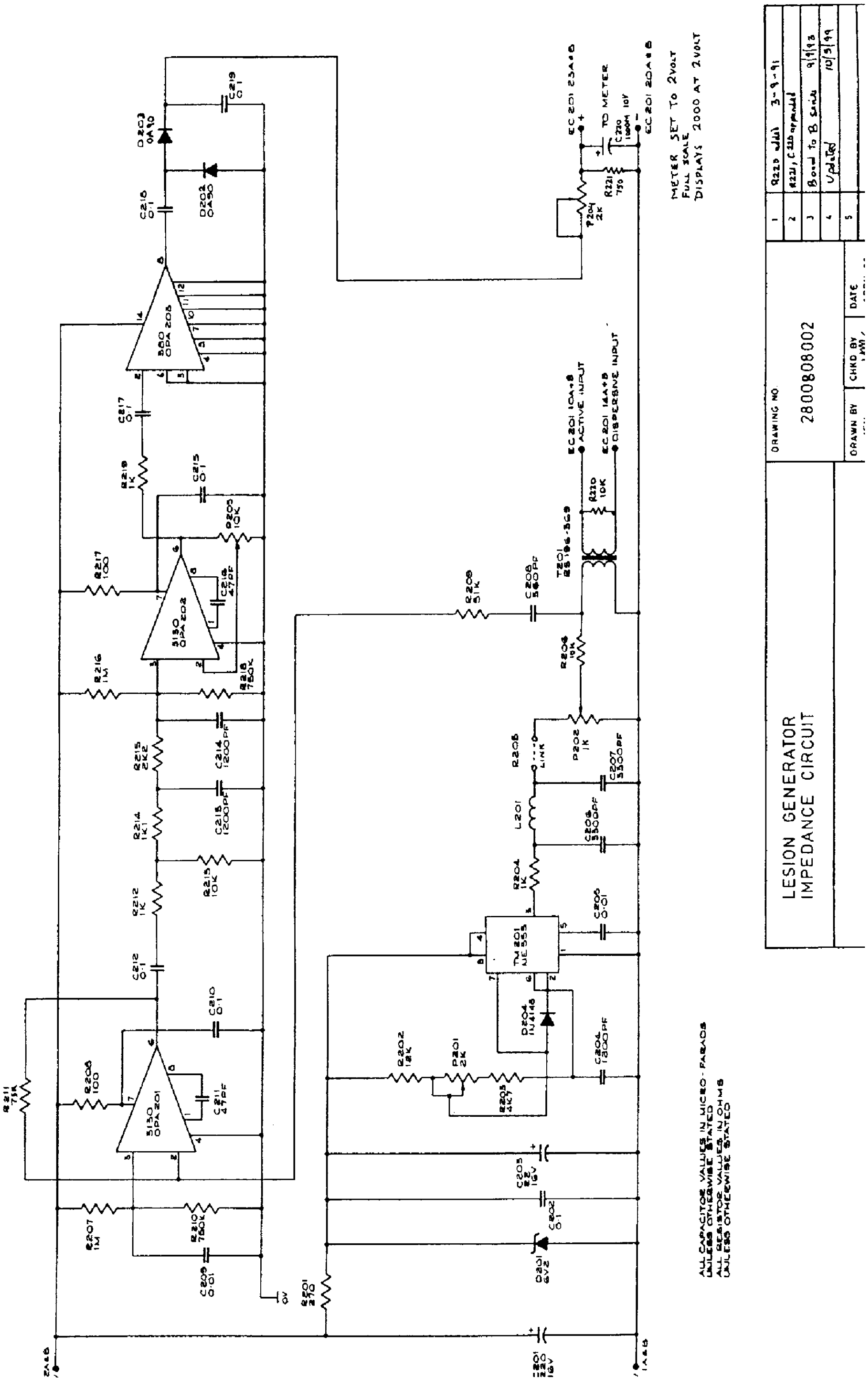
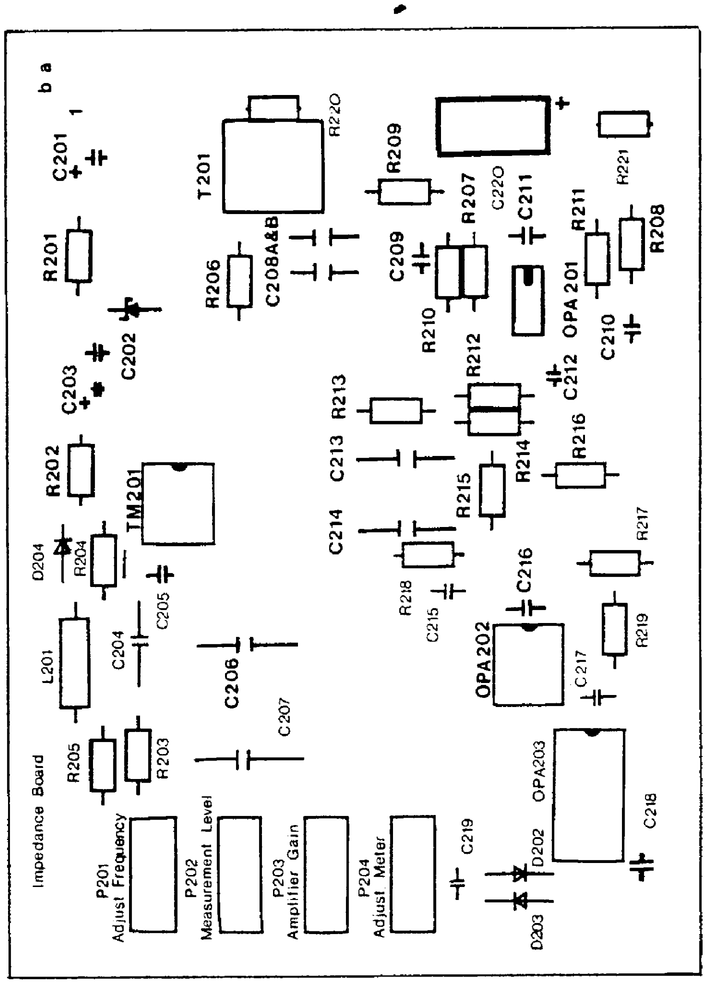

LESION GENERATOR
IMPEDANCE CIRCUIT
DRAWING NO.
2800808002
DRAWN BY
CHKD BY
DATE
1 R220 added 3-9-91
2 R221, C220 appended
3 Board to B Series 9/9/93
4 Updated 10/5/99
5
EC201 23A+B +
TO METER
C220 100UM 10V
EC201 20A+B −
R221 750
P204 2K
METER SET TO 2VOLT
FULL SCALE
DISPLAYS 2000 AT 2VOLT
EC201 10A+B ACTIVE INPUT
EC201 14A+B DISPERSIVE INPUT
R220 10K
TZ01 BS196-3C9
C208 560PF
R208 5.1K
R206 10K
P202 1K
R205 LINK
C207 3300PF
C206 3300PF
L201
R204 1K
C205 0.01
IM201 NE555
D204 1N4148
C204 1800PF
R202 18K
P201 2K
R203 4K7
C203 22 16V
C202 0.1
D201 6V2
R201 270
Z201 220 16V
ALL CAPACITOR VALUES IN MICRO-FARADS UNLESS OTHERWISE STATED
ALL RESISTOR VALUES IN OHMS UNLESS OTHERWISE STATED
D203 OA90
D202 OA90
C219 0.1
C216 0.1
350 OPA205
C217 0.1
R219 1K
C215 0.1
P205 10K
R217 100
3130 OPA202
C218 47PF
R216 1M
R218 750K
R215 2K2
C214 1200PF
R214 1K1
C213 1200PF
R213 10K
R212 1K
C212 0.1
C210 0.1
R211 75K
R209 100
3130 OPA201
C211 47PF
R207 1M
R210 750K
C209 0.01
0V
2A&B
1A&B

Figure 6.4 Impedance Board - 2800808002 - Component Layout


b a
1
C201
R201
C202
C203
R202
D204
R204
C205
C204
L201
R205
R203
Impedance Board
P201 Adjust Frequency
P202 Measurement Level
P203 Amplifier Gain
P204 Adjust Meter
T201
R220
R206
C208A&B
TM201
C206
C207
R209
C209
R210
R207
C220
C211
R211
R221
R208
OPA 201
C210
R212
C212
R213
C213
R214
R215
R216
C214
R218
C215
C216
R217
R219
OPA202
C217
OPA203
C218
C219
D202
D203

6.3 Stimulate Board – 2800808003C

Components:-

R301A	16K	¼W 5% Carbon Film
R301B	Not Fitted	
R302A	33K	¼W 5% Carbon Film
R302B	620K	¼W 5% Carbon Film
R303	3K	¼W 5% Carbon Film
R304	6K2	¼W 5% Carbon Film
R305	470K	¼W 5% Carbon Film
R306	560	¼W 5% Carbon Film
R307	4K7	¼W 5% Carbon Film
R308	10K	¼W 5% Carbon Film
R309	15K	¼W 5% Carbon Film
R310	2K2	¼W 5% Carbon Film
R311	150K	¼W 5% Carbon Film
R312	3K9	¼W 5% Carbon Film
R313	33	¼W 5% Carbon Film
R314	10K	¼W 5% Carbon Film
R315	10K	¼W 5% Carbon Film
R316	300K	¼W 5% Carbon Film
R317	10K	¼W 5% Carbon Film
R318	30K	¼W 5% Carbon Film
R319	27K	¼W 5% Carbon Film
R320	10K	¼W 5% Carbon Film
R321	330	¼W 5% Carbon Film
P301	10K	25 turn Trimmer Type 94P
P302	100K	25 turn Trimmer Type 94P
P303	2K	25 turn Trimmer Type 94P
C301	47MF	16V Tantalum
C302	680nF	100V Polyester
C303	10nF	100V Polyester
C304	470MF	16V Electrolytic
C305	100nF	63V Polyester
C306	10nF	100V Polyester
C307	100nF	63V Polyester
C308	10nF	100V Polyester
C309	470pF	100V Ceramic
C310	1000MF	16V Electrolytic
C311	470nF	63V Polyester
D301	IN4148	Diode
TR301	2N3704	Transistor
TM301	NE556	Dual Timer

Z301	LM747	Dual Operational Amplifier
Z302	LM358	Dual Operational Amplifier
Z303	HCF4047	Multivibrator
RLA	12V	Double Pole Subminiature Relay
RLB1	10V	Double Pole Subminiature Relay
RLB2	10V	Double Pole Subminiature Relay
S301	Sounder	IMO
TF301	1+1:2+2	Transformer
TF302	1+1:2+2	Transformer
EC 301	64 way connector	DIN 41612 Type B
Green Handle		

Figure 6.5 Stimulate Board - 2800808003BC- Circuit Diagram

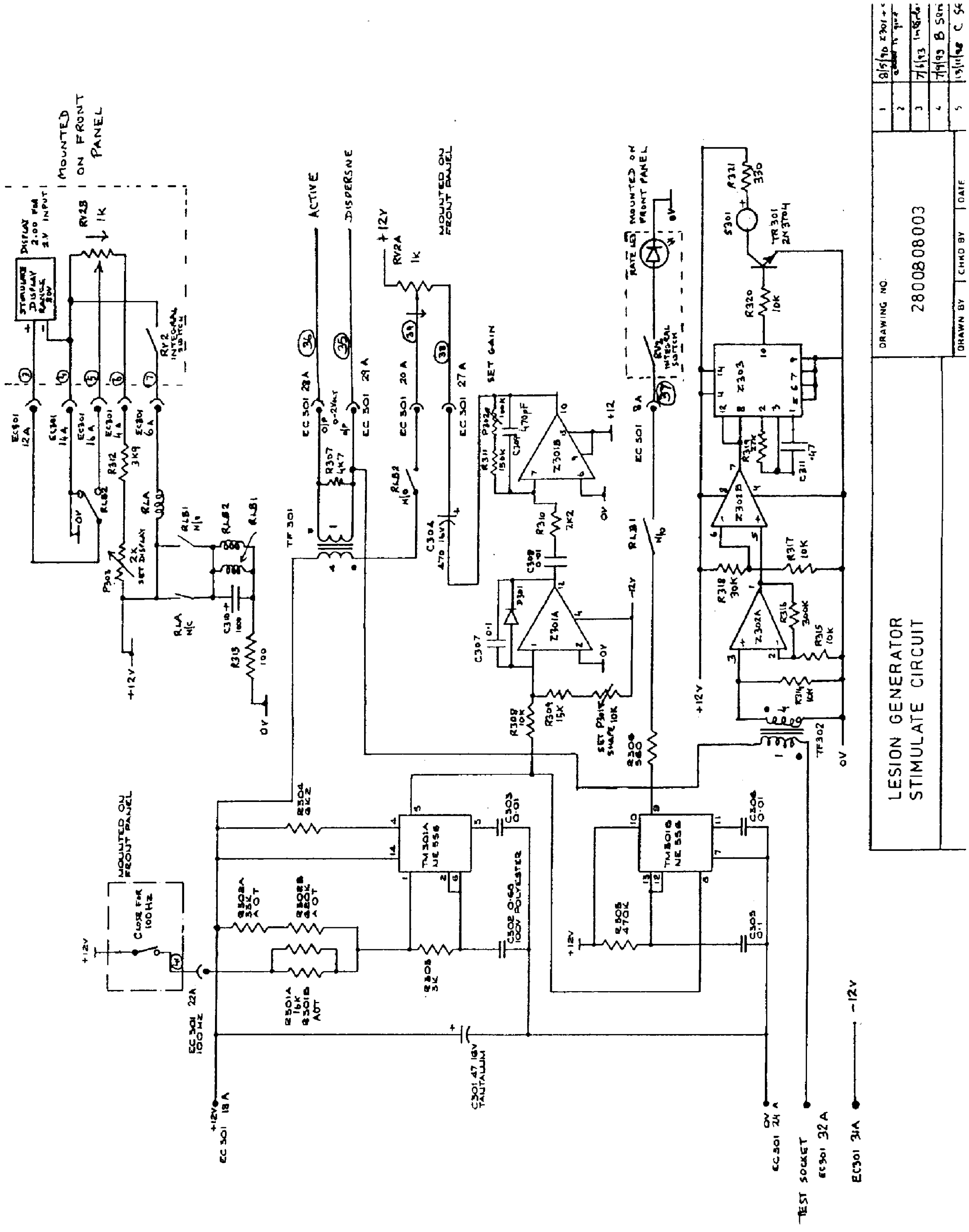
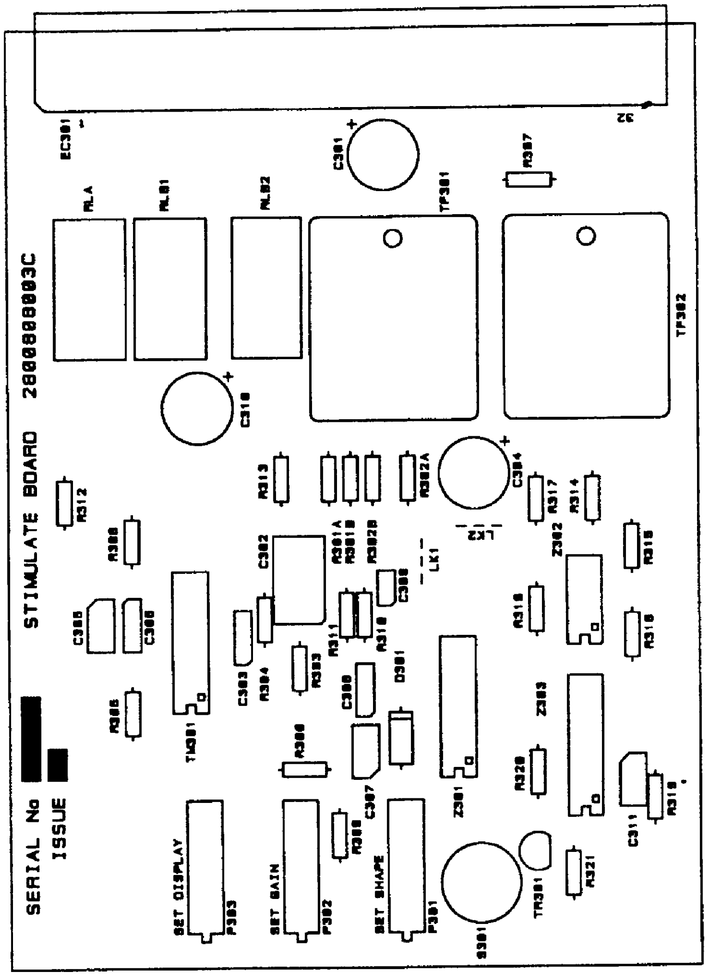

LESION GENERATOR
STIMULATE CIRCUIT
DRAWING NO.
2800808003
DRAWN BY
CHKD BY
DATE
MOUNTED ON FRONT PANEL
ACTIVE
DISPERSIVE
+12V
RV2A
1K
RV2B
1K
STIMULATE DISPLAY
SET GAIN
RATE LED
Z301A
Z301B
Z302A
Z302B
Z303
TR301
2N3704
S301
R321
330
R320
10K
TF301
TF302
TM301A
NE556
TM301B
NE556
C301 47 16V TANTALUM
C302 0.68 100V POLYESTER
C303
0.01
C304
0.01
C305
0.1
C306
470 16V
R304
6K2
R305
470Ω
R306
560
R307
4K7
R308
3K
R309
15K
R310
2K2
R311
150K
R312
3K9
R313
100
R314
10K
R315
10K
R316
300K
R317
10K
R318
30K
R319
27K
SET SHAPE 10K
CLOSE FOR 100Hz
EC301 18A
EC301 22A
100Hz
EC301 24A
EC301 32A
EC301 31A
TEST SOCKET
0V
-12V
+12V

Figure 6.6 Stimulate Board - 2800808003 - Component Layout


STIMULATE BOARD 2800808003C
SERIAL No
ISSUE
EC301
32
RLA
RLB1
RLB2
C301
R307
TF301
TF302
C310
R312
R309
C305
C306
R305
TM301
R313
C302
R301A
R301B
R302B
R302A
C304
LK1
LK2
R317
R314
Z302
R318
R316
R315
R311
R310
C308
D301
C303
R304
R303
C309
R306
C307
R308
Z301
Z303
R320
C311
R319
TR301
R321
S301
SET DISPLAY
P303
SET GAIN
P302
SET SHAPE
P301

6.4 RF Generator Board - 2800808004A

Components

R401	24	¼W 5% Carbon Film	
R402	2R7	¼W 5% Carbon Film	
R403	10	¼W 5% Carbon Film	
R404	5K1	¼W 5% Carbon Film	
R405	200	¼W 5% Carbon Film	
R407	1K	¼W 5% Carbon Film	
C401	470pF	Silver Mica	}
C402A	33nF	63V Polystyrene	} CAPACITORS
C402B	33nF	63V Polystyrene	} IN
C402C	33nF	63V Polystyrene	} PARALLEL
C402D	Not fitted		
C403	100nF	63V Polyester	
C404	1MF	250V Polyester	
C405	10000pF	Polypropolene	
C406	100nF	63V Polyester	
D401	IN4148	Signal Diode	
FET401	IRF 530	MOSFET Transformer	
ZD401	BZY 88	15V Zener Diode	
ZD402	BZY 88	15V Zener Dioder	
OPTO401	MCA 2231X	Opto Isolator	
TF401	Transformer with 3 windings		
VREG401	LM317T	Variable Voltage Regulator	
Heatsink	Type 07WN00750A200		
Red Handle			
EC401	32 way connector	DIN 41612 Type D	

Figure 6.7 RF Generator - 2800808004A - Circuit Diagram

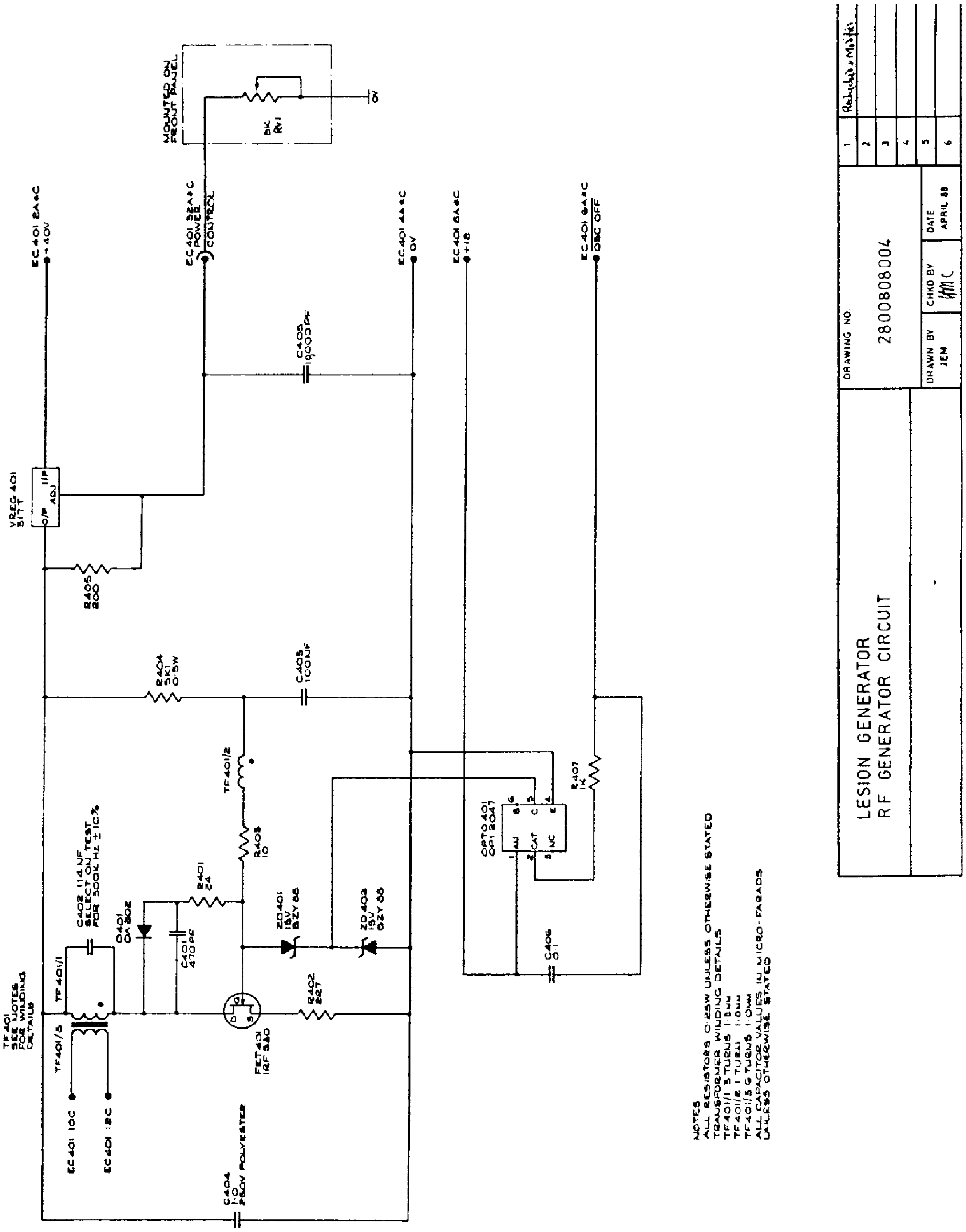
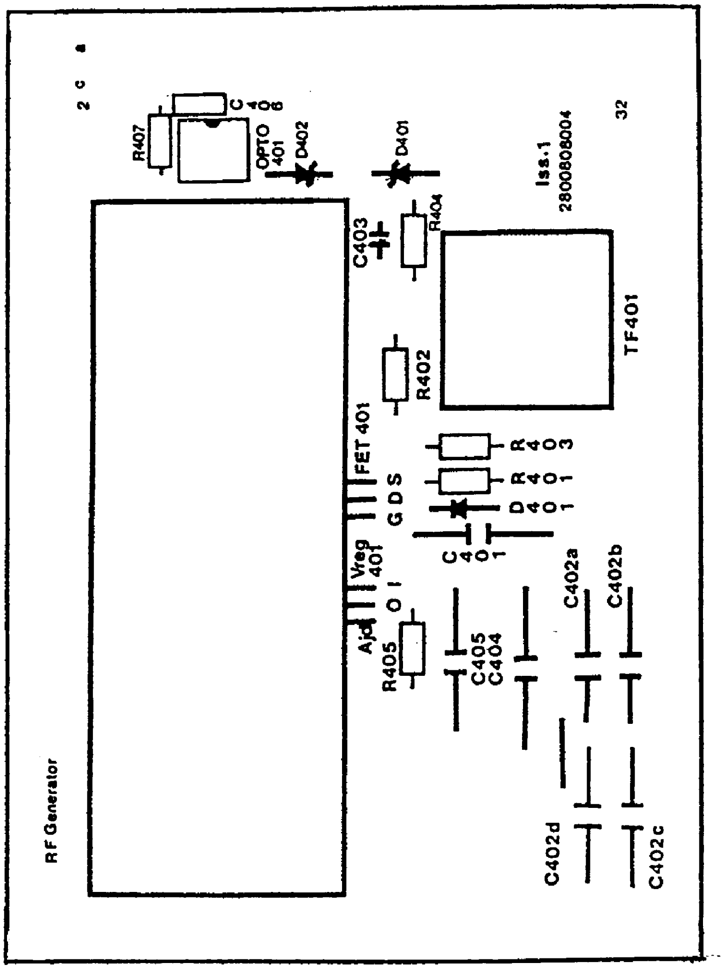

MOUNTED ON FRONT PANEL
5K RV1
EC401 2A&C +40V
EC401 3Z4&C POWER CONTROL
EC401 4A&C 0V
EC401 5A&C +18
EC401 6A&C OSC OFF
C405 10000PF
VREG401 317T
I/P
ADJ
O/P
R405 200
R404 5K1 0.5W
C403 100NF
TF401/2
R403 10
R401 24
C402 114NF SELECT ON TEST FOR 300K Hz ± 10%
D401 OA202
C401 470PF
ZD401 15V BZY88
ZD402 15V BZY88
R402 227
FET401 IRF830
TF401 SEE NOTES FOR WINDING DETAILS
TF401/1
TF401/3
EC401 10C
EC401 12C
C404 1.0 250V POLYESTER
OPTO401 OPI 2047
R407 1K
C406 0.1
NOTES
ALL RESISTORS 0.25W UNLESS OTHERWISE STATED
TRANSFORMER WINDING DETAILS
TF401/1 5 TURNS 1.0MM
TF401/2 1 TURN 1.0MM
TF401/3 6 TURNS 1.0MM
ALL CAPACITOR VALUES IN MICRO-FARADS UNLESS OTHERWISE STATED
DRAWING NO 2800808004
DRAWN BY JEM
CHKD BY HMC
DATE APRIL 88
LESION GENERATOR
RF GENERATOR CIRCUIT

Figure 6.8 RF Generator Board - 2800808004 - Component Layout


2 c a
R407
C408
OPTO 401
D402
D401
Iss.1
2800808004
32
C403
R404
TF401
R402
FET 401
G D S
R403
R401
D401
C401
Vreg 401
O I
Adj
R405
C405
C404
C402a
C402b
C402d
C402c
RF Generator

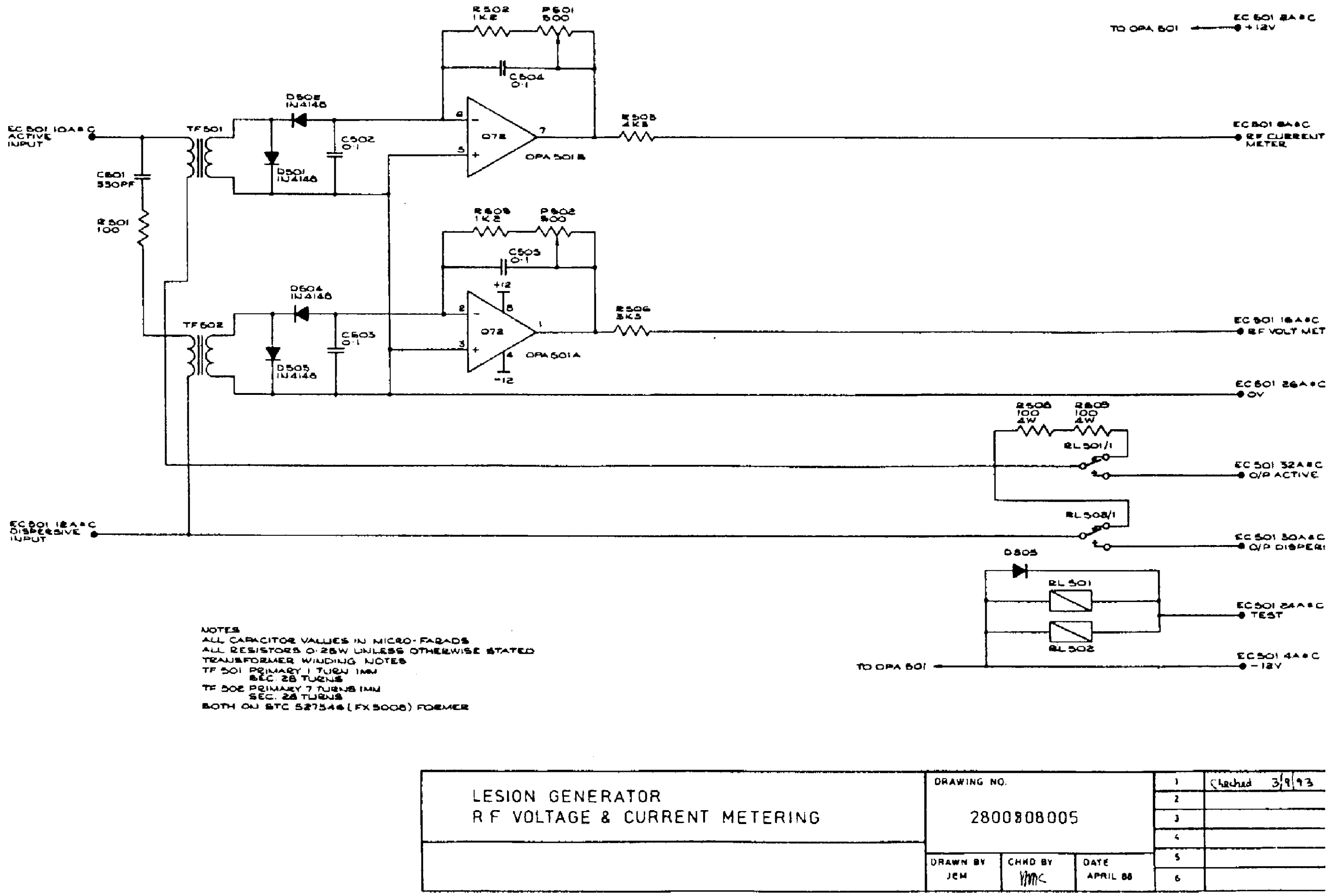
6.5 RF Voltage and Current Metering Board - 2800808005A

Components

R501	100	¼W 5% Carbon Film
R502	1K2	¼W 5% Carbon Film
R503	4K3	¼W 5% Carbon Film
R505	1K2	¼W 5% Carbon Film
R506	3K3	¼W 5% Carbon Film
R508	100	¼W 5% Carbon Film
R509	100	¼W 5% Carbon Film
P501	500	25 turn Trimmer Type 94P
P502	500	25 turn Trimmer Type 94P
C501	330pF	Silver Mica 630V
C502	100nF	63V Polyester
C503	100nF	63V Polyester
C504	100nF	63V Polyester
C505	100nF	63V Polyester
D501	IN4148	
D502	IN4148	
D503	IN4148	
D504	IN4148	
D505	IN4148	
OPA501	TL072N	
TF501	1:28 Transformer	on FX3008 Former
TF502	7:28 Transformer	on FX3008 Former
RL501	FBR211 24V	Single Pole Relay
RL502	FBR211 24V	Single Pole Relay
EC501	32 way connector DIN 41612 Type D	

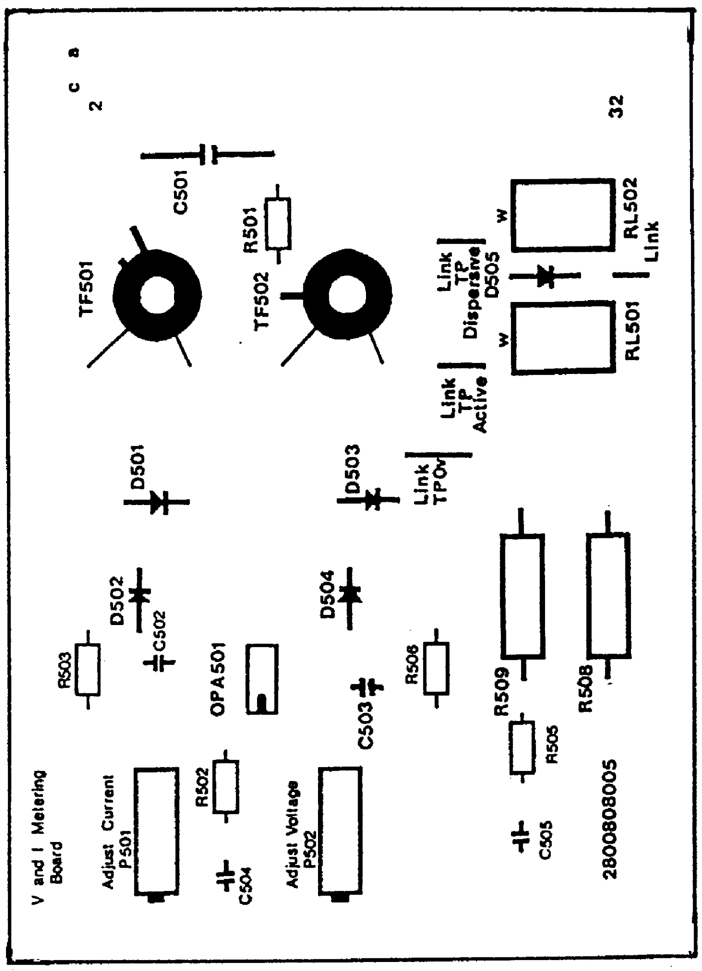
Black Handle

Figure 6.9 RF Voltage and Current Metering Board 2800808005A - Circuit Diagram


EC 501 10A+C ACTIVE INPUT
C501 330PF
R501 100
TF501
TF502
D502 1N4148
D501 1N4148
C502 0·1
D504 1N4148
D505 1N4148
C503 0·1
R502 1K2
P501 500
C504 0·1
072
OPA501B
R505 4K8
R503 1K2
P502 500
C505 0·1
+12
-12
OPA501A
R504 3K3
EC 501 12A+C DISPERSIVE INPUT
TO OPA 501
EC 501 8A+C +12V
EC 501 6A+C RF CURRENT METER
EC 501 16A+C RF VOLT MET
EC 501 26A+C 0V
R506 100 4W
R509 100 4W
RL501/1
EC 501 32A+C O/P ACTIVE
RL502/1
EC 501 30A+C O/P DISPER!
D505
RL501
RL502
EC 501 24A+C TEST
TO OPA 501
EC 501 4A+C -12V
LESION GENERATOR
R F VOLTAGE & CURRENT METERING
DRAWING NO.
2800808005
DRAWN BY JCM
CHKD BY
DATE APRIL 88
1 Checked 3/9/93
2
3
4
5
6

NOTES
ALL CAPACITOR VALUES IN MICRO-FARADS
ALL RESISTORS 0·25W UNLESS OTHERWISE STATED
TRANSFORMER WINDING NOTES
TF 501 PRIMARY 1 TURN 1MM
SEC. 28 TURNS
TF 502 PRIMARY 7 TURNS 1MM
SEC. 28 TURNS
BOTH ON STC 527546 (FX 5008) FORMER

Figure 6.10 RF Voltage and Current Metering Board - 2800808005 - Component Layout


c
a
2
32
C501
R501
TF501
TF502
Link
TP
Dispersive
D505
w
RL502
Link
w
RL501
Link
TP
Active
D501
D503
Link
TPOv
D502
C502
D504
R503
OPA501
R506
C503
R509
R508
R505
V and I Metering
Board
Adjust Current
P501
R502
C504
Adjust Voltage
P502
C505
2800808005

6.6 Temperature Board – 2800808006D

Components

R601	1K	¼W 5% Carbon Film
R602	6K8	¼W 5% Carbon Film
R603	82K	¼W 5% Carbon Film
R604	2K2	¼W 5% Carbon Film
R605	2K2	¼W 5% Carbon Film
R606	2K2	¼W 5% Carbon Film
R607	2K2	¼W 5% Carbon Film
R608	12K	¼W 5% Carbon Film
R609	3K	¼W 5% Carbon Film
R610	1M	¼W 5% Carbon Film
R611	22K	¼W 5% Carbon Film
R612	6K8	¼W 5% Carbon Film
R613	3K9	¼W 5% Carbon Film
R614	5K1	¼W 5% Carbon Film
R615	Not fitted	
R616	10K	¼W 5% Carbon Film
R617	5K1	¼W 5% Carbon Film
R618	330K	¼W 5% Carbon Film
R619	13K	¼W 5% Carbon Film
R620	4K7	¼W 5% Carbon Film
R621	10K	¼W 5% Carbon Film
R622	5K1	¼W 5% Carbon Film
R623	10K	¼W 5% Carbon Film
R624	IK	¼W 5% Carbon Film
P601	20K	25 turn Trimmer Type 94P
P602	10K	25 turn Trimmer Type 94P
P603	1K	25 turn Trimmer Type 94P
P604	2K	20 turn Trimmer Type 94P
P605	2K	20 turn Trimmer Type 94P
P606	10K	20 turn Trimmer Type 94P
C601	100nF	63V Polyester
C602	100nF	63V Polyester
C604	100nF	63V Polyester
C605	10nF	100V Polyester
C606	10nF	100V Polyester
C607	100nF	63V Polyester
C608	100nF	63V Polyester
C609	100nF	63V Polyester
C610	10nF	100V Polyester
C611	10nF	100V Polyester

C612	2.2MF	63V Polyester
C613	10nF	100V Polyester
C614	100nF	63V Polyester
D601	IN4148	Diode
D602	IN4148	Diode
D603	IN4148	Diode
D604	IN4148	Diode
D605	TC04BCZM	1.26V Precision Bandgap Voltage Reference
TR601	2N3705	Transistor
TR602	BC337	Transistor
Z601	AD595CQ	Thermocouple Amplifier
Z602	LM311N	Voltage Comparator
Z603	TL071	Operational Amplifier
Z604	NE555N	Timer
RL601	Double Pole Relay 12V	
RL602	Double Pole Relay 12V	
EC601	64 way Connector DIN 41612 Type B	
Blue Handle		

Figure 6.11 Temperature Board – 2800808006D - Circuit Diagram

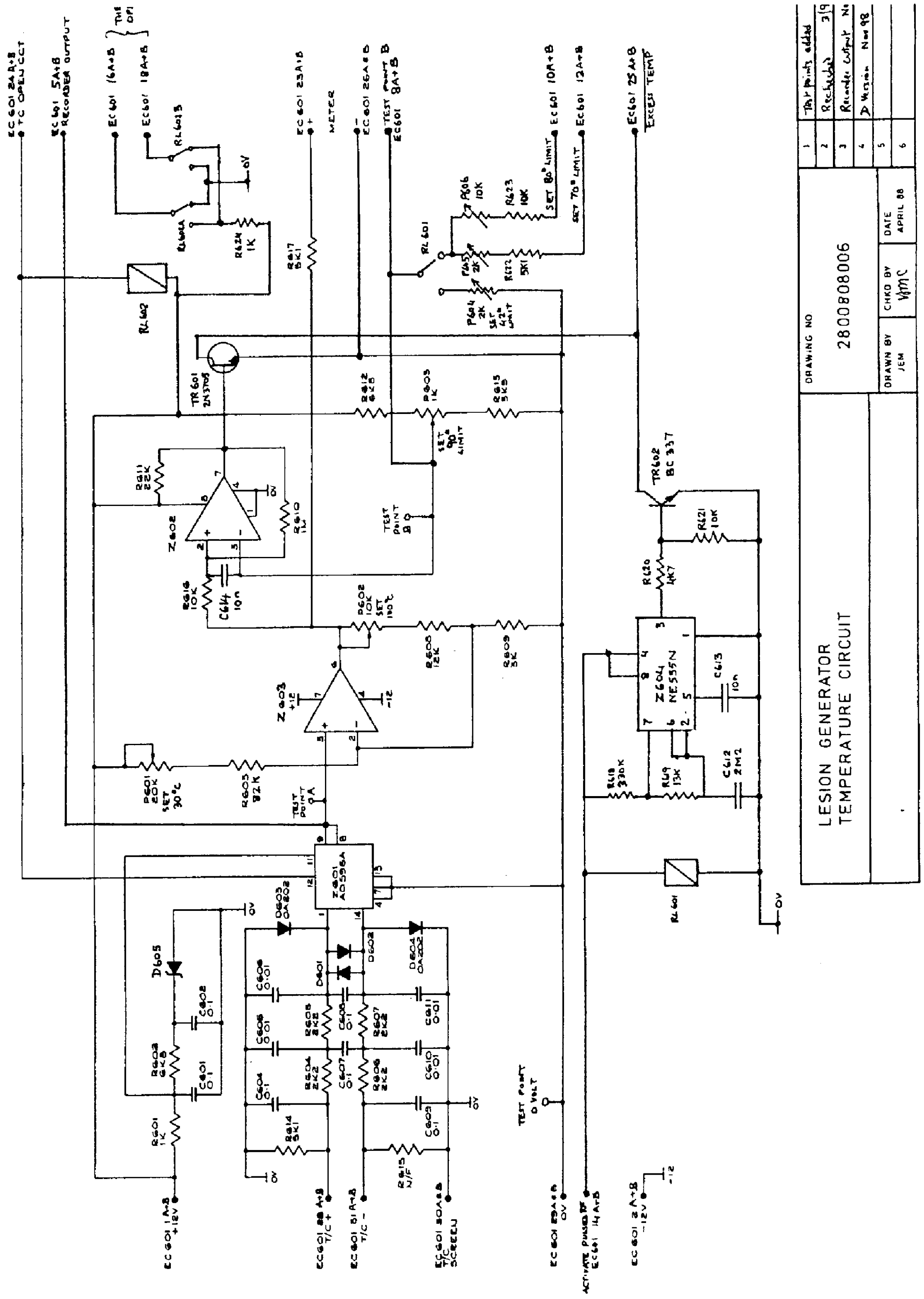
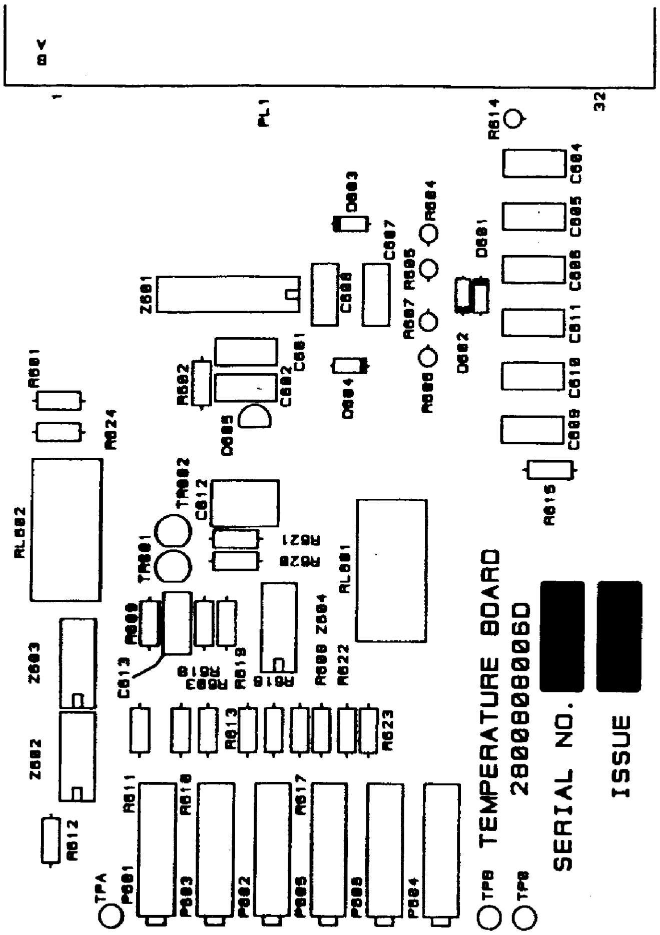

LESION GENERATOR
TEMPERATURE CIRCUIT
DRAWING NO
2800808006
DRAWN BY
JEM
CHKD BY
DATE
APRIL 88
Test points added
Rechecked
Recorder output
Version Nov 98
EC601 24A+B T/C OPEN CCT
EC601 5A+B RECORDER OUTPUT
EC601 16A+B
EC601 18A+B
EC601 23A+B +
METER
EC601 26A+B −
TEST POINT B EC601 8A+B
EC601 10A+B
EC601 12A+B
EC601 25A+B EXCESS TEMP
RL601
RL602
TR601 2N3703
TR602 BC337
Z601 AD596A
Z602
Z603
Z604 NE555N
R601 1K
R602 6K8
R603 92K
R604 2K2
R605 12K
R606 2K2
R607 2K2
R608 2K2
R609 3K
R610 1M
R611 22K
R612 6K8
R614 5K1
R615 5K1
R616 10K
R617 5K1
R618 330K
R619 13K
R620 4K7
R621 10K
R622 5K1
R623 10K
R624 1K
P601 20K SET 30°C
P602 10K SET 100°C
P603 1K SET 90° LIMIT
P604 2K SET 42° LIMIT
P605 2K
P606 10K
SET 80° LIMIT
SET 70° LIMIT
C601 0.1
C602 0.1
C603 0.1
C604 0.1
C605 0.1
C606 0.01
C607 0.1
C608 0.01
C609 0.1
C610 0.01
C611 0.01
C612 2M2
C613 10n
C614 10n
D601
D602
D603 OA202
D604 OA202
D605
TEST POINT 9A
TEST POINT 9B
TEST POINT 0 VOLT
EC601 1A+B +12V
EC601 28A+B T/C +
EC601 31A+B T/C −
EC601 30A+B T/C SCREEN
EC601 29A+B 0V
ACTIVATE PULSED RF EC601 14A+B
EC601 2A+B −12V
0V
+12
−12

Figure 6.12 Temperature Board - 2800808006 - Component Layout


PL1
1
32
TEMPERATURE BOARD
2800808006D
SERIAL NO.
ISSUE
R614
C604
C605
C606
C611
C610
C609
R615
D601
D602
D603
D604
D605
R604
R605
R606
R607
C607
C608
Z601
C601
C602
R602
R601
R624
RL602
TR601
TR602
C612
R620
R621
RL601
R609
C613
R603
R618
R619
R616
R608
Z604
R622
Z602
Z603
R612
R611
R610
R613
R617
R623
TPA
P601
P603
P602
P605
P606
P604
TPB

6.7 Timer and Interlock Board – 2800808007D

Components

R701	1K	¼W 5% Carbon Film
R702	1K5	¼W 5% Carbon Film
R703	Not fitted	
R704	10K	¼W 5% Carbon Film
R705	10K	¼W 5% Carbon Film
R706	4K7	¼W 5% Carbon Film
R707	10K	¼W 5% Carbon Film
R708	33K	¼W 5% Carbon Film
R709	10K	¼W 5% Carbon Film
R710	10K	¼W 5% Carbon Film
R711	1K	¼W 5% Carbon Film
R712	3K3	¼W 5% Carbon Film
R713	3K3	¼W 5% Carbon Film
R714	10K	¼W 5% Carbon Film
R715	22K	¼W 5% Carbon Film
R716	22K	¼W 5% Carbon Film
R717	47K	¼W 5% Carbon Film
R718	22K	¼W 5% Carbon Film
R719	47K	¼W 5% Carbon Film
R720	22K	¼W 5% Carbon Film
R721	47K	¼W 5% Carbon Film
R722	1K	¼W 5% Carbon Film
R723	1K	¼W 5% Carbon Film

C701	220MF	16V Electrolytic
C702	Not fitted	
C703	Not fitted	
C704	100nF	63V Polyester
C705	100nF	63V Polyester
C706	100nF	63V Polyester
C707	100nF	63V Polyester
C708	1MF	50V Electrolytic
C709	1MF	50V Electrolytic

D701	IN4001	Signal Diode
D702	IN4001	Signal Diode
D703	IN4001	Signal Diode
D704	IN4001	Signal Diode
D705	In4148	Diode

RV 701	10K	25 turn Trimmer Type 94P

Z701	LM 3909N	LED Flasher
Z702	4541	Programmable Timer
Z703	4001B	Quad 2 Input CMOS NOR Gates
Z704	4013B	
Z705	4001B	

T701	2N 3705	Transistor
T702	BC337	Transistor
T703	BC337	Transistor
T704	BC337	Transistor

RLA	BT Double Pole Relay	10V Coil
RLD	BT Double Pole Relay	12V Coil
RLE	BT Double Pole Relay	12V Coil
RLG	BT Double Pole Relay	12V Coil

Connector	DIN 41612	Type C	Connectors A+C	Even Contacts

Handle - Yellow

Figure 6.13 Timer and Interlock Board – 2800808007D - Circuit Diagram

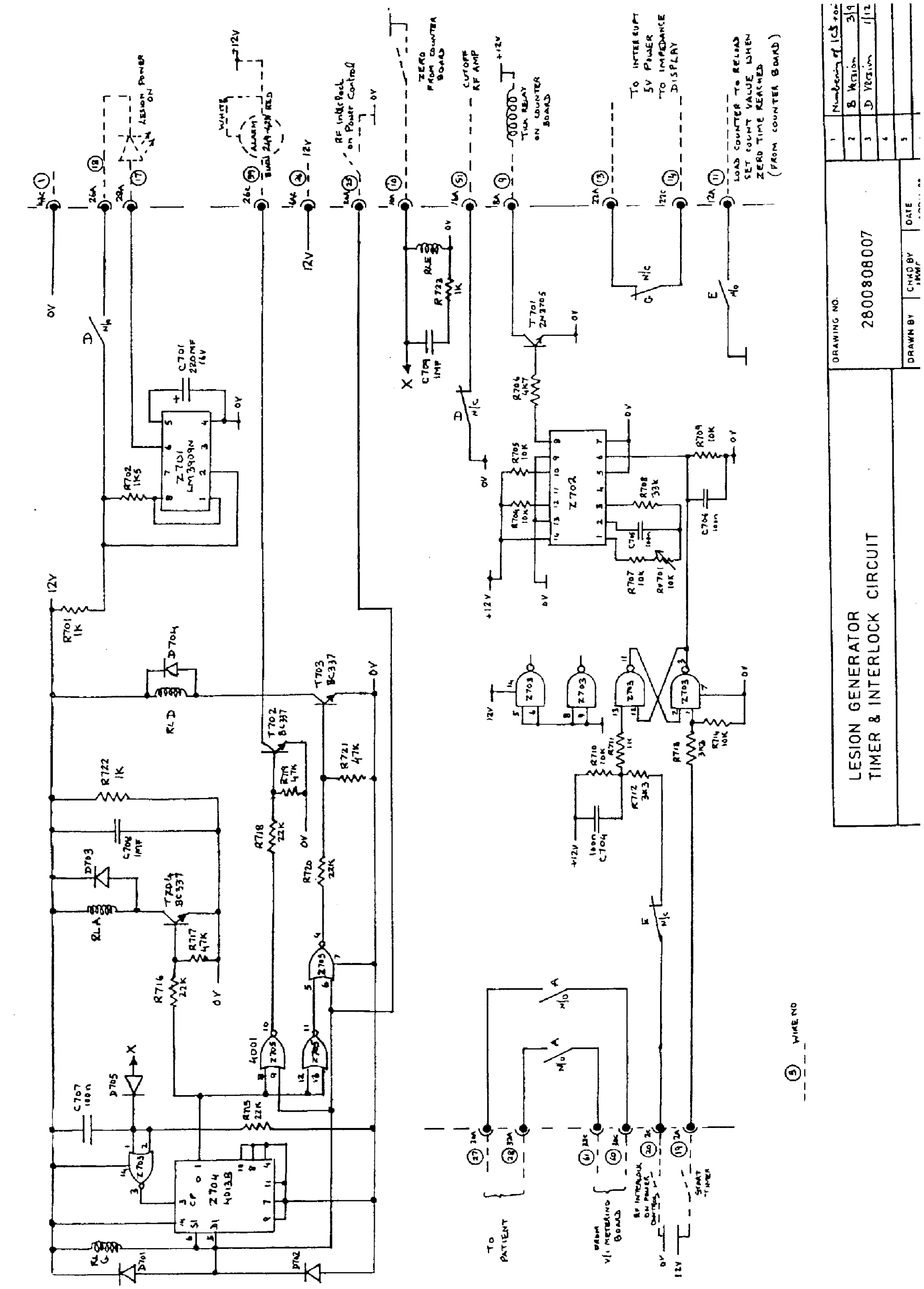
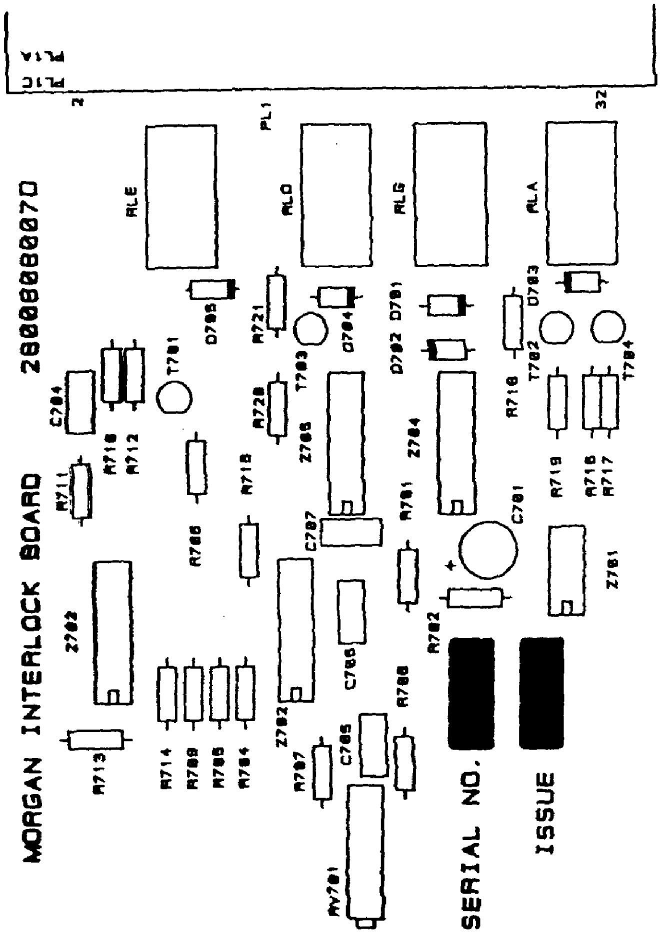

LESION GENERATOR
TIMER & INTERLOCK CIRCUIT
DRAWING NO.
2800808007
DRAWN BY
CHKD BY
DATE
Z701 LM3909N
Z702
Z703
Z704 4013B
Z705 4001
T701 2N3705
T702 BC337
T703 BC337
T704 BC337
C701 220MF 16V
RLA
RLD
RLE
RLG
TO PATIENT
START TIMER
12V
0V
+12V

Figure 6.14 Timer and Interlock Board - 2800808007 - Component Layout

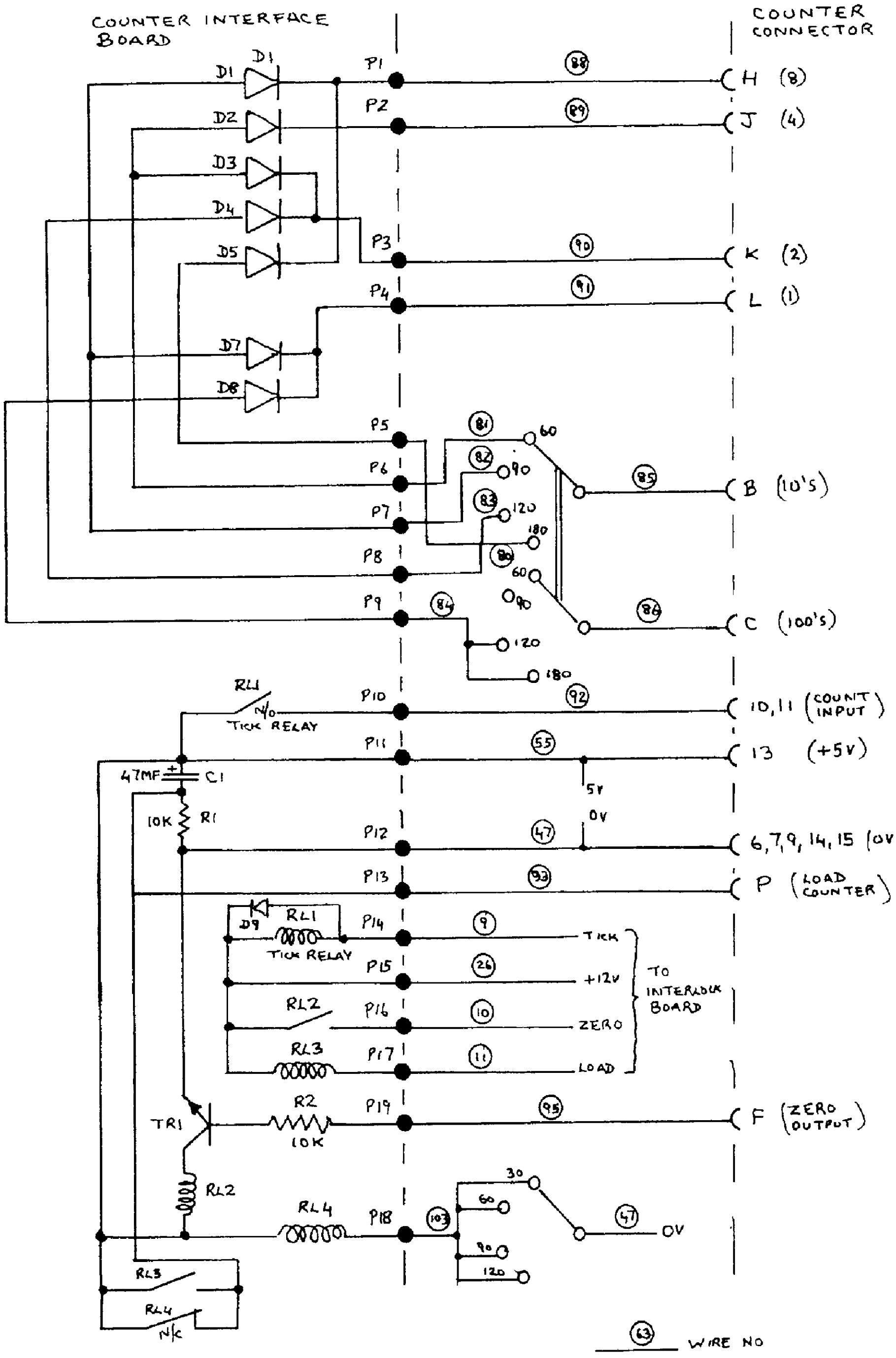

PL1A
PL1C
2
PL1
32
RLE
RLD
RLG
RLA
28000808070
MORGAN INTERLOCK BOARD
D705
R721
D704
D701
D703
T701
T703
D702
T702
T704
C704
R710
R712
R720
Z705
Z704
R716
R719
R715
R717
R711
R718
R706
C707
R701
C701
Z701
Z703
R702
C706
R708
R714
R709
R705
R704
Z702
R707
C705
RV701
SERIAL NO.
ISSUE

6.8 Counter Interface Board – 2800808008C

Components

R1	10K	1/8W 5%Metal Film
R2	10K	1/8W 5% Metal Film
C1	47MF	6.3V Electrolytic
D1	IN4148	Signal Diode
D2	IN4148	Signal Diode
D3	IN4148	Signal Diode
D4	IN4148	Signal Diode
D5	IN4148	Signal Diode
D6	Not fitted	Signal Diode
D7	IN4148	Signal Diode
D8	IN4148	Signal Diode
D9	IN4148	Signal Diode
TR1	2N 3704	Transistor
RL1	12V	Miniature Single Pole Relay
RL2	5V	Miniature Single Pole Relay
RL3	12V	Miniature Single Pole Relay
RL4	5V	Miniature Single Pole Relay

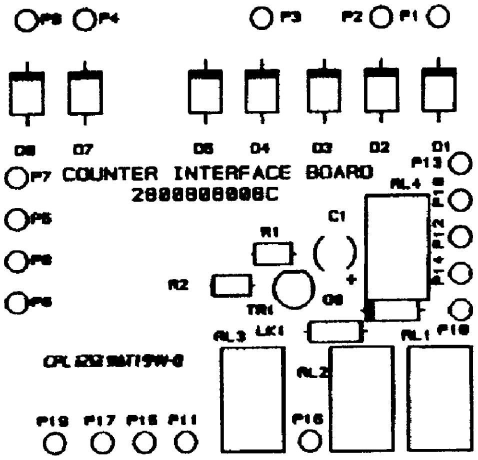
Figure 6.15 Counter Interface Board – 2800808008C - Circuit Diagram


COUNTER INTERFACE BOARD
COUNTER CONNECTOR
D1
D2
D3
D4
D5
D7
D8
D9
P1
P2
P3
P4
P5
P6
P7
P8
P9
P10
P11
P12
P13
P14
P15
P16
P17
P18
P19
88
89
90
91
81
82
83
80
84
85
86
92
55
47
93
9
26
10
11
95
103
H (8)
J (4)
K (2)
L (1)
60
90
120
180
B (10's)
C (100's)
RL4
N/O
TICK RELAY
10,11 (COUNT INPUT)
13 (+5V)
47MF
C1
10K
R1
5V
0V
6,7,9,14,15 (0V)
P (LOAD COUNTER)
RL1
TICK RELAY
RL2
RL3
TICK
+12V
ZERO
LOAD
TO INTERLOCK BOARD
TR1
R2
10K
F (ZERO OUTPUT)
RL2
RL4
30
60
90
120
0V
RL3
RL4
N/C
63 WIRE NO

COUNTER INTERFACE BOARD 2800808008

7-1-94
UPDATED 10-5-99

Figure 6.16 Counter Interface Board - 2800808008 - Component Layout


P5
P4
P3
P2
P1
D8
D7
D5
D4
D3
D2
D1
P13
P7
COUNTER INTERFACE BOARD
2800808008C
RL4
P10
P12
P14
P6
P8
P9
C1
R1
R2
+
TR1
D9
RL3
LK1
RL1
P18
RL2
P19
P17
P15
P11
P16

6.9 Fuse Board – 2800808001D

R101	1K	6 watt Vitreous
F101	Fuseholder with cover	
F102	Fuseholder with cover	
F103	Fuseholder with cover	
F104	Fuseholder with cover	
Fuses	1 AMP T (Bussmann)	101 to 104
Black Handle		
Edge connector	DIN41612	Type B

Fig 6.17 Fuse Board 2800808001D – Circuit Diagram

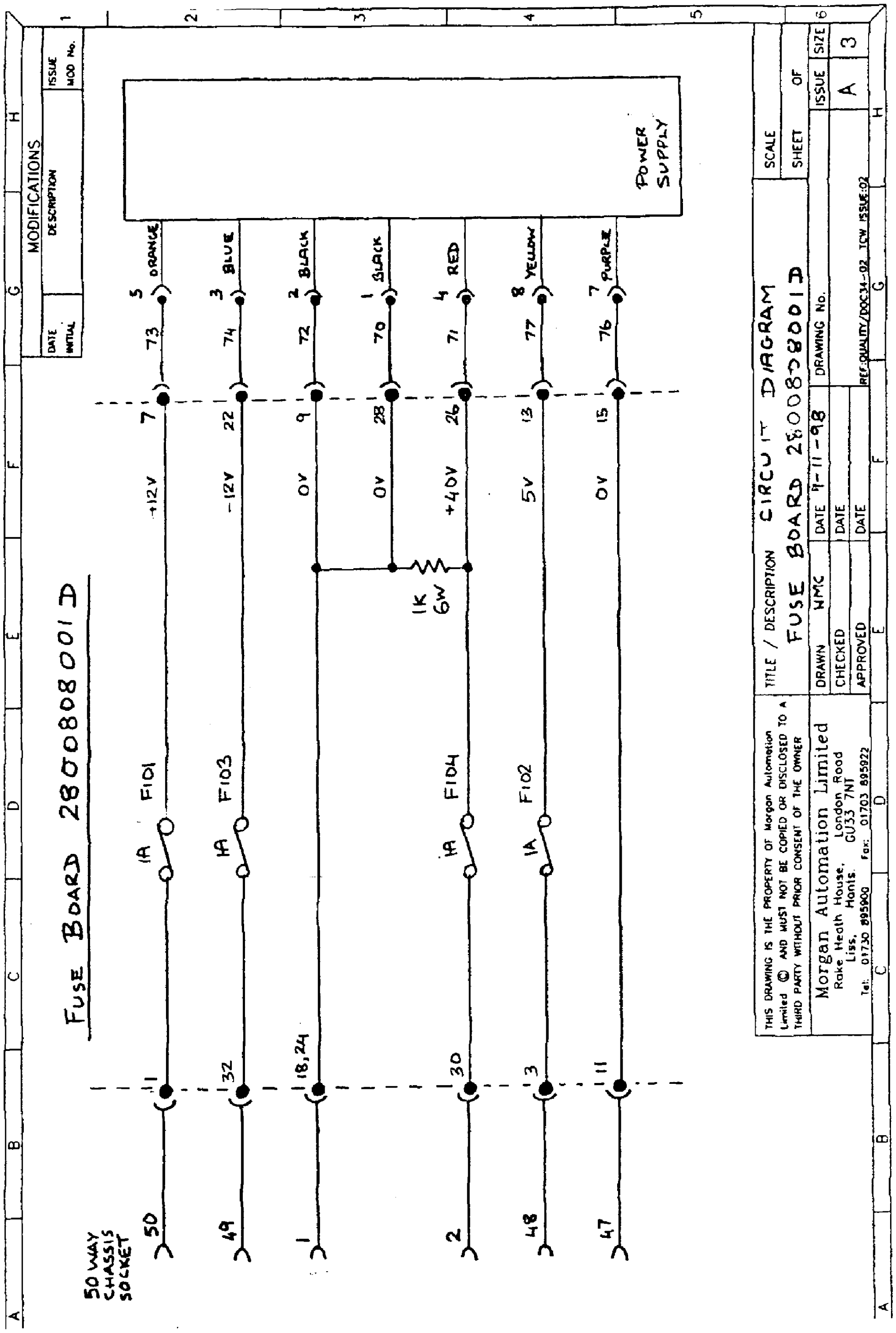
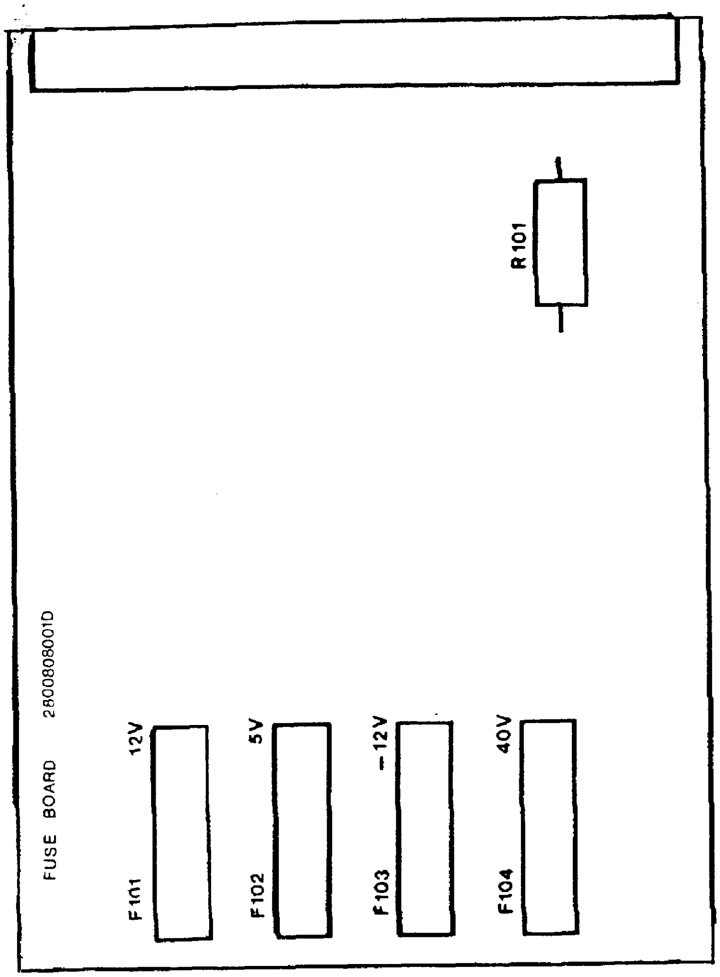

POWER SUPPLY
5 ORANGE 73 7 +12V
3 BLUE 74 22 -12V
2 BLACK 72 9 0V
1 BLACK 70 28 0V
4 RED 71 26 +40V
8 YELLOW 77 13 5V
7 PURPLE 76 15 0V
1K 6W
FUSE BOARD 2800808001 A
1A F101
1A F103
1A F104
1A F102
1
32
18,24
30
3
11
50 WAY CHASSIS SOCKET
50
49
1
2
48
47
MODIFICATIONS
ISSUE
MOD No.
DESCRIPTION
DATE
INITIAL
TITLE / DESCRIPTION
CIRCUIT DIAGRAM
FUSE BOARD 2800808001 A
SCALE
SHEET OF
ISSUE A
SIZE 3
DRAWN HMC
DATE 9-11-98
CHECKED
DATE
APPROVED
DATE
DRAWING No.
REF: QUALITY/DOC34-02 TCW ISSUE:02
THIS DRAWING IS THE PROPERTY OF Morgan Automation Limited © AND MUST NOT BE COPIED OR DISCLOSED TO A THIRD PARTY WITHOUT PRIOR CONSENT OF THE OWNER
Morgan Automation Limited
Rake Heath House, London Road
Liss, Hants. GU33 7NT
Tel: 01730 895900 Fax: 01730 895922
A B C D E F G H
1 2 3 4 5 6

Fig 6.18 Fuse Board 28008001D – Component Layout


R101
FUSE BOARD 28008080001D
12V
5V
−12V
40V
F101
F102
F103
F104

6.10 General System Schematic - 2800809001

Components

RV1	4K7 1W Potentiometer with integral 2 pole switch
RV2	2 gang potentiometer, each gang 1K,1W with integral ON/OFF switch
C1	1000MF 25V Electrolytic
SW1	Function Switch – 6 positions - 9 pole
SW2	Start Time Switch - 2 positions - 1 pole with spring return
SW3	Stimulator Rate Switch - 2 positions - 1 pole
SW4	Lesion Time - 4 positions - 3 pole
SW5	Max Temperature – 3 positions – 1 pole
M1	0-1mA DC Movement Meter - Temperature
M2	0-1MA DC Movement Meter - 0 to 200mA RMS
M3	0-1mA DC Movement Meter - 0 to 40V RMS
DIG 1	Digital Panel Meter 3½ digit - to display impedance
DIG 2	Digital Panel Meter 3½ digit - to display stimulate voltage
DIG 3	Digital Counter 4 digit - to display time
IND 1	Meter Illumination 6mm x 24mm 6V Festoon Bulb
IND 2	Meter Illumination 6mm x 24mm 6V Festoon Bulb
IND 3	Meter Illumination 6mm x 24mm 6V Festoon Bulb
IND 4	Green LED with Bezel - Mains
IND 5	Green LED with Bezel - Stimulate Rate
IND 6	Amber LED with Bezel - Lesion Power On
IND 7	Green/Red LED with Bezel – Thermocouple Open Circuit
D 1	IN 4002 Diode
AL 1	2 Tone Alarm Sounder

6.10 General System Schematic - 2800809001 (continued)

SKT 1	LEMO	ECG	OB-304C
SKT 2	4mm	Shrouded Socket - Black	
SKT3	Test Socket 4mm Black		

Mains Input Connection

Corcom Power Input Unit Type 6V MIS complete with Mains On/Off Switch and 2 fuses.

Transformer

Primary 0-120V, 0-120V 50/60Hz

Double Bobbin Section

Secondary 1	30V RMS at 1A RMS
Secondary 2	15V RMS at 1A RMS
Secondary 3	15V RMS at 1A RMS
Secondary 4	12V RMS at 1A RMS

Thermal Fuse fitted in primary winding

Figure 6.19 General System Schematic - 2800809001 - Circuit Diagram

Diagram available on request

7.0 SERVICE AND TROUBLESHOOTING

7.1 General Service Information

There are several levels of service available these are:-

24 hour Loan Service.

A Loan machine will be despatched to any UK customer within 24 hours of receip of order. The Loan Unit will be sent in a strong carrying case so that the unit fo repair can be returned to RDG Medical via prepaid carriage. The hospital unit wil be returned after repair in the same type of carrying case. The Loan Unit can the be returned to RDG Medical.

Loan Units will be charged on a daily basis with a minimum charge for carriag and return.

24 hour Board Replacement Service.

For those customers who have established EBME repair facilities, RDG Medica will provide a full PCB replacement service. RDG Medical will despatch within 2 hours of receipt or order, a fully tested replacement board for delivery the next day.

Usually field service is limited to swapping the suspect circuit board etc., the fault board can then be repaired at RDG Medical.

If you need to seek service advice, please quote the unit serial number, produc revision letter and a detailed fault description. After any replacement see Sectio 8.1 (adjustments) and after any service perform the functional field check procedur as outlined in Chapter 9.

Depending on the capabilities of the EBME repair facility some repairs may not b possible. In such cases the faulty parts should be sent to RDG Medical for repair.

The tests and repair outlined in this section should only be attempted b trained personnel with the appropriate equipment. Unauthorised service ma void the warranty and its associated guarantees.

7.2 Disassembly and Reassembly

1 Access to the Boards is achieved by removing the name plate panel on th back of the machine, secured by 4 M4 screws.

2 The machine is disassembled by:-

a) Removing the 2 outer M4 screws on the rear panel
b) Removing the 6 M4 screws along the two sides of the machine

The top housing of the machine can now be separated from the bottom housing however the cable from the card rack to the front connectors will restrict how fa the two can be separated.

The cable harness length to the front panel is so designed that the top housing ca be placed on its right hand side next to the right hand side of the machine, and th front panel can be connected in this position.

The front panel is connected to the main rack by a 50 way connector.

All boards within the machine are then totally accessible and can individually b removed from their rack or operated on extender boards.

It is possible to fully operate and monitor the internal workings of the machine wit the cover off. There are no voltage in excess of 40V DC on the rack, cards or fron panel.

Assembly is essentially reversing what was described above, however some cautio is necessary. Before replacing the top housing check that all internal connectors ar in place, the 50 way front panel connector has its retainers fully secured, and th cables to the front connectors are not snagged or trapped in any way.

The top housing is then placed over the base and secured with the 10 screws.

7.3 Troubleshooting

7.3.1 Basic Troubleshooting

This section deals with very basic Troubleshooting which should alway be carried out prior to attempting major repair.

SYMPTOM	POSSIBLE CAUSE AND REMEDY
MAINS LAMP DOES NOT LIGHT	Unit is not receiving power Check Mains Cable i correctly inserted into a wall socket and into the rea socket of the machine. Check the mains switch on wall socket and rear o machine is in the 'ON' position. Check fuses in rear o machine or fuse in mains plug (if fitted).
ON IMPEDANCE FUNCTION IMPEDANCE SHOWS OPEN CIRCUIT	Problems with Dispersive Plate Lead. Check th Dispersive Plate Lead is correctly connected and plugge into the Front Panel Socket. To test that the Impedance Function is operating correctl turn FUNCTION SWITCH to TEST position and chec that displayed reading is approximately 500 ohms
NO OUTPUT AT ACTIVE PROBE	Problems with Ancillary Cables. Check LESION selecte on Function Switch and Lesion Power control turned o and then on. Check that the Temperature Probe i correctly plugged into front panel connector. If in doubt, replace Temperature Probe. To test whether the machine is internally generating R Power, turn FUNCTION SWITCH to TEST Position an turn Lesion Power Control clockwise. Observe meter which both should move to full scale deflection at th fully clockwise position of the control.

7.3.1 Basic Troubleshooting

SYMPTOM	POSSIBLE CAUSE AND REMEDY
LOW RF POWER AT ACTIVE PROBE	Problems with Dispersive Electrode or lead. Chec Dispersive Plate is securely applied. If in doubt chang for a new one. (If patient impedance is above 200 ohms as power is applied RF voltage will increase faster tha RF Current - this can be observed on the two meters). I impedance is too high the lesion power available will no be sufficient to achieve a high temperature at the lesio point.

If this Basic Troubleshooting fails to remedy the fault either:-

a) Report the fault to RDG Medical for a machine exchange;

or

b) Contact an authorised Service Engineer;

or

c) Carry out the further troubleshooting as detailed belo

7.3.2 Further Troubleshooting

Further troubleshooting or field service of this machine is intended to b done as board swapping where possible. Thus the most important part o troubleshooting is to pin-point the faulty module.

In order to carry out this further troubleshooting it is necessary to remov the name plate cover at the back of the machine, or dissassemble th machine as detailed in Section 7.2.2.

Leave the Front Panel connected to the Card Rack and put the top housin on its right hand side next to the right hand side of the machine. Ensure a Circuit Boards are pushed fully home in the Card Rack.

Connect Mains Lead.

Follow through the procedure outlined below, omitting sections a necessary:-

SYMPTOM	PROCEDURE	PROBABLE FAULT AREA
	Switch on.	
MAINS LAMP ON FRONT PANEL DOES NOT LIGHT	Check rear fuses and mains plug fuse, check that mains voltage is available at machine. With meter and prods check that AC voltages are present at the pins of the secondary side of the mains transformer	REAR FUSES MAI INPUT UNIT MAINS POWER TRANSFORMER
	If these voltages are not present, either the mains input socket is faulty or transformer has blown its thermal fuse.	

7.3.2 Further Troubleshooting (continued)

SYMPTOM	PROCEDURE	PROBABLE FAULT AREA
	Put Fuse Board on an extender board or lead and check DC Voltages at the four 1Amp Fuses.	
	'0 volts' is available on the rear of the Board on Terminals 11,18,24,28. The '0 volts' for the 5V supply is on Terminal 11. The output side of the four fuses is near the front edge of the board.	INTERNAL FUSES
	From the top of the board, fuses are for +12V, 5V -12V, 40V.	
	If a fuse has blown, it is likely that either the power supply is faulty or another board is shorting out one of the supply lines.	POWER SUPPLY BOARD FAULTY
	Turn off machine and leave for some minutes for capacitors to discharge. Check the impedance of each power line (at the fuses) to 0 volts. For the 5V supply check to the '0 volts' of this supply (i.e. Terminal 11). If any power line is low impedance, disconnect boards one at a time to find offending board.	SHORT CIRCUIT ON CIRCUIT BOARD
	If power supply is at fault and it is obvious where the fault lies, replace component or request a replacement board.	

7.3.2 Further Troubleshooting (continued)

SYMPTOM	PROCEDURE	PROBABLE FAULT AREA
DISPLAYS AND METERS FAIL TO LIGHT WHEN FUNCTION IS SELECTED	If all meter lights are inoperative fault is either at the transformer, power supply board or Function Switch SW1. Check transformer as above, and 5v supply on Power Supply Board. If these are intact then check wiring to Function Switch (Wire 48) or meter commons (Wire 47). If a single meter lamp fails to come on, check internal Festoon bulb or associated wiring.	POWER SUPPLY BOARD/FUSE FUNCTION SWITCH LAMP WIRING METER BULBS
RF POWER CANNOT BE GENERATED WITH FUNCTION SWITCH IN TEST POSITION	The fault either lies on the RF Generator Board or on the RF Voltage and Current Metering Board. Put RF Generator Board on an Extender Lead and check DC output voltage of VREG 401 goes from 3 to 37V when Lesion Power Control is turned clockwise, if not fault lies with either external potentiometer or Regulator. If DC voltage control is correct, connect an oscilloscope between Pins 10 and 12 of edge connector of RF Generator Board. Signal should be 110V peak to peak at 300KHz sine wave with Power Control Potentiometer fully clockwise.	RF GENERATOR OR RF VOLTAGE AND CURRENT METERING BOARD VREG 401 ON RF GENERATOR BOARD OR LESION POWER CONTROL

7.3.2 Further Troubleshooting (continued)

SYMPTOM	PROCEDURE	PROBABLE FAUL AREA
	If this sine wave is present check the RF Voltage and Current Metering Board. Put Board on an Extender Lead and check that RL501 and RL502 are energised when Test Position is selected on the Function Switch, i.e. check 24V is present across diode D505. Check 110V 300KHz sine wave is present across R508 and R509. If voltage is present then check metering circuit and associated wires to meters.	RF VOLTAGE AND CURRENT METERING BOARD
RF POWER NOT AVAILABLE IN LESION POSITION	Connect a 200 ohm load between Dispersive socket and Temperature Probe, and check meters move up together to full scale with increasing clockwise rotation of Lesion Power Potentiometer. If they do not, check RF Generator Board and Voltage and Current Metering Boards as above. If these Boards operate correctly check 300KHz sine wave across Pins 32C and 30C on Timer and Interlock Board and between 30A and 32A on the Board. If the signal is available on the 32C and 30C Terminals but not on 30A and 32A then interlock system on the Board should be investigated. If signal is available check wiring to front connectors.	TIMER AND INTERLOCK BOARD WIRING TO FRONT CONNECTOR

7.3.2 Further Troubleshooting (continued)

SYMPTOM	PROCEDURE	PROBABLE FAULT AREA
IMPEDANCE MEASUREMENT FAILS TO OPERATE	With Function Switch in the Impedance Position connect a 500 ohm resistor across Pins 10A and 14A of IMPEDANCE BOARD. Check whether Impedance Meter reads. If it does, then check wiring from Card to Function Switch. If Display fails to read check wiring to Display. Check voltages (0 and +12v) are available on board, if not check Function Switch. If voltages are present request a replacement Impedance Board.	WIRING TO FUNCTION SWITCH IMPEDANCE BOARD
STIMULATE FUNCTION FAILS TO OPERATE	With Function Switch in the Stimulate Position check voltage across Pins 28 and 29 of Stimulate Board Edge connector using an oscilloscope. With Stimulate rate set to 100Hz.	
	Positive and Negative going pulses should be observed (1mS wide) whose height varies with the Stimulate Voltage Control. If no pulses are observed, check -12V and +12V supplies - if these are not present check wiring to Function Switch. If pulses are present but not getting to front panel connectors check wiring to Function Switch and to front panel connectors. See System Schematic Wiring Diagram Figure 6-19.	WIRING TO FUNCTION SWITCH

7.3.2 Further Troubleshooting (continued)

SYMPTOM	PROCEDURE	PROBABLE FAULT AREA
	If voltages are present but there is no output from board, check timer output Pins 5 and 9 of TM301A for pulses. Replace timer if necessary or request a replacement board.	TIMER TM301A STIMULATE BOARD
TEMPERATURE FUNCTION FAILS TO OPERATE	With Function Switch in Test Position, connect either a probe or signal injector into the front panel connector and vary effective input temperature. If no movement is observed on meter, check whether signal is arriving at the Temperature Board by observing voltage across Pins 1 and 14. Note voltages are very small at these points (1mV per 25°C) - see Figure 5-10 for expected signal levels. If voltage is not present check wiring to front panel.	FRONT CONNECTOR WIRING
	If voltage is present, check output of Z601A at Test Point A and 0V.	
	Signal should be 10mV/°C as detailed in Figure 5.10. If voltage is not present Z601 is suspect.	Z601 ON TEMPERATURE BOARD
	If voltage is present check output of Z603. If this voltage is present, check wiring to meter.	TEMPERATURE METERING WIRING
	If the Board appears faulty first check that the +12V and -12V supplies are present before requesting a replacement Board.	TEMPERATURE BOARD

7.3.2 Further Troubleshooting (continued)

SYMPTOM	PROCEDURE	PROBABLE FAULT AREA
SYSTEM FAILS TO REDUCE POWER WHEN TEMPERATURE EXCEEDS 90°C	This fault is either caused by the Temperature Board not sending an Excess Temperature Signal to the RF Generator Board, or the Opto Isolator (OPTO401) not operating.	
	With Function Switch in Test Position, apply some Lesion Power so that RF Voltage and Current Meters read. Connect a signal injector into the front connectors and turn it up so that the temperature meter moves above 90°C.	
	Meters should show decreasing output as temperature moves above 90°C.	Z602 ON TEMPERATURE BOARD
	If meters fail to show decreasing power, check function of Z602. Pin 7 should change state when voltage on Pin 2 exceeds that on Pin 3.	
	Check voltage on Pin 3 is set at correct level for 90°C Cut out.	TR601 ON TEMPERATURE BOARD
	If Z602 operates correctly check that Pin 25 on edge connector operates. If not TR601 is suspect. If it is correct check wiring between Temperature and RF Generator Boards or replace OPTO401 on RF Generator Board.	OPTO401 ON GENERATOR BOARD

7.3.2 Further Troubleshooting (continued)

SYMPTOM	PROCEDURE	PROBABLE FAULT AREA
CLOCK FAILS TO START OR OPERATES INCORRECTLY	If clock fails to start when the Function Switch is in the LESION position and Lesion Power Control is on, then check state of Z702 Programmable Timer and whether a pulse train of one second pulse are coming from Pin 8. Check that Pin 1 of Z703 goes high when start timer is held clockwise. Check Pin 13 is low, if not check appropriate switches.	LESION POWER CONTROL SWITCH TIMER START SWITCH Z702 OR Z703 ON TIMER AND INTERLOCK BOARD
	If clock appears to misoperate check Counter and Counter Interface Board. Replace if necessary.	COUNTER AND COUNTER INTERFACE BOARD
	Check status of all interlocks by putting the Timer and Interlock Board on an extender card.	
	If interlock conditions are correct and Board still fails to operate correctly - replace the Board.	TIMER AND INTERLOCK BOARD

8.0 ADJUSTMENTS

Adjustments are limited to 5 boards namely.

Impedance Board	(2800808002)
Stimulate Board	(2800808003)
Voltage and Current Metering Board	(2800808005)
Temperature Board	(2800808006)
Timer and Interlock Board	(2800808007)

8.1 Adjustments after component replacements

After any component replacement check from the following table which adjustments have to be performed:-

Component Replaced	Adjustments
Transformer or Power Supply Board	All controls may need adjustment on: Impedance Board Stimulate Board Voltage and Current Metering Board Temperature Board
RF Voltage or Current Meters	Voltage and Current Metering Board
Temperature Meter	Temperature Board
Impedance Display	Impedance Board
Impedance Board or any component on it	Impedance Board
Stimulate Board or any component on it	Stimulate Board
Voltage and Current Metering Board or any component on it	Voltage and Current Metering Board
Temperature Board or any Component on it	Temperature Board
Timer and Interlock Board or any Component on it	Timer and Interlock Board

8.2 Impedance Board (2800808002) Adjustments

1. Connect Mains Power to the machine.

2. Connect the Test Box to the Active and Dispersive sockets on the front of the machine and set the load to 500 ohms.

3. Turn Main Function Switch to Impedance Position.

4. Connect Impedance Board on an extender lead so that it is clear of the card rack.

5. Connect an oscilloscope between 0V (Pin 1) and Pin 3 of TM201 (one end of R204).

6. Switch on Machine.

7. Adjust Frequency Potentiometer (P201) to obtain 53KHz (19µS) 5V peak to peak square wave signal with ON time (5V) = 3 x OFF time (0V).

8. Connect scope between 0V and wiper of P202 (one end of R206). Adjust Measuring Level Potentiometer P202 to get 1V peak to peak 53KHz signal (rounded saw tooth) with small high frequency component. This signal sits 200mV above 0V line.

9. Connect scope between 0V and junction of D202 and D203. Adjust Amplifier Gain (P203) to get 2.5V peak to peak 53 Khz signal with no ringing for 500 ohm load.

   Equivalent voltage for other loads:-

200 ohm	1 volt
500 ohm	2.5 volts
1000 ohm	4 volts

10. Adjust P204 (Adjust Meter Potentiometer) to get correct reading at 500 ohms. Observe reading at 1K ohms and slightly adjust P203 and P204 both clockwise or anti-clockwise to get best fit over impedance range. Ensure display goes overscale on open circuit output..

11. Check that amplifier does not ring or fold over by connecting 1K5 ohm load, monitoring signal on junction of D202 and D203, and disconnecting and reconnecting dispersive lead. If there is any sign of signal oscillating or if amplifier folds over, reduce the output by turning P203 clockwise and restore meter scale reading by turning P204 clockwise.

12. Lock the four trimmers with varnish.

8.3 Stimulate Board (2800808003) Adjustments

1. Connect Mains Power to the Machine.
2. Connect the Test Box to the Active and Dispersive Sockets on the front of the machine and set the load to 500 ohms.
3. Switch on and turn Main Function Switch to Stimulate Position.
4. Turn Stimulate Rate Switch to 100Hz and Stimulate Amplitude Control fully clockwise.
5. Connect an oscilloscope across the output terminals of the machine.
6. Adjust set shape potentiometer on Stimulate Board (P301) to get positive and negative pulses of equal amplitude.
7. Adjust Set Gain potentiometer on Stimulate Board (P302) to get 2 volts positive and negative pulses.
8. Adjust Set Display Potentiometer (P303) to get 2 volt display on Front Panel Display.
9. Lock the trimmers with varnish

8.4 Voltage and Current Metering Board (2800808005) Adjustments

1. This board is operational in the "TEST" and "LESION" positions of the Function Switch.

2. With the Function Switch in the LESION Position connect a Test Load of 200 ohms between the Active and Dispersive sockets on the front of the machine.

3. Connect an oscilloscope across the output terminals of the machine and turn Lesion Power Control fully clockwise. Signal obtained should be a 300KHz sine wave of about 110V peak to peak.

4. Measure maximum peak to peak value and calculate RMS voltage value as below:-

$$\text{RMS Voltage} = \frac{\text{Peak to Peak Voltage}}{2.828}$$

5. Adjust P502 (Adjust Voltage) to get RMS Voltage meter to read the correct RMS Voltage on the meter (should be near full scale).

6. Calculate RMS Current as below:-

$$\text{RMS Current} = \frac{\text{RMS Voltage}}{200}$$

7. Adjust P501 (Adjust Current) to get RMS Current Meter to read correct value (should be near full scale).

8. Lock the two trimmers with varnish.

8.5 Temperature Board (2800808006) Adjustments

1. This board is operational in the “TEST” and “LESION” positions of the Function Switch.
2. With the Function Switch in the LESION Position connect a Test Load of 200 ohms between the Active and Dispersive sockets on the front of the machine.
3. Connect the Temperature Board on an extender so it is clear of the Card Rack.
4. With the Function Switch in the Lesion Position inject a signal of approximately 1.2mV into the thermocouple input pins of the Active socket to give an output of 310mV when measured on Test Point A on the Board. Adjust P601 (set 30°C) to get meter to read 30°C.
5. Inject a signal of approximately 4mV into the thermocouple input pins of the Active Socket to give an output of 1025mV when measured on Test Point A on the Board. Adjust P602 (set 100°C) to get meter to read 100°C.
6. With Temperature Limit Switch in 90°C position adjust voltage injector signal to get a meter reading of 90°C. Measure voltage on Pin 2 Z602. Adjust P603 (set Cut off) to get the same voltage on Test Point B.
7. Test Cut Out control by turning down temperature by reducing voltage injector signal. Turn Lesion Power On to get full scale readings on the RF Voltage and Current Meters. Increase voltage injector signal and check that when temperature reading increases above 90°C, the RF Current and Voltage Signals decrease.
8. With Temperature Limit Switch in 80°C position set meter reading to 80°C and repeat #6 by adjusting P606.
9. Repeat above at 70°C adjusting P605.
10. Swich Mode to Pulsed RF and repeat above at 42°C with P604.
11. Lock all trimmers with varnish.

8.6 Timer and Interlock Board (2800808007) Adjustments

1. This board is operational in the 'TEST' and 'LESION' positions of the Function Switch.
2. With the Function Switch in the 'TEST' position, set time on the Digital Counter on the Front Panel to 60 seconds.
3. Turn the Lesion Power Switch ON.
4. Start the timer and observe the countdown from 60 seconds to zero.
5. Check the time taken by the counter against a stopwatch.
6. If the two times are not in agreement, adjust RV701 as appropriate and repeat stages 3 to 5 until they are the same.
7. Repeat procedure with 120 seconds on the counter.
8. When satisfied that the two times are within one second over a 120 second period, lock the trimmers with varnish.

9.0 FUNCTIONAL FIELD CHECK PROCEDURES

The following test should be carried out after any service to ensure proper operation of the equipment

1. Switch the equipment ON.
2. Check that the green MAINS Indicator is illuminated.
3. Connect Test Box to Active and Dispersive connectors.
4. Switch Function Switch to TEST Position, check Impedance Display reads approximately 500 ohms. Check two RF Meters and Temperature Meter light up. Turn power up and check RF Voltage and RF Current go to Full Scale on their meters.
5. Turn up voltage on Test Box and observe Temperature moves up scale on Temperature Meter. Set Temperature Limit Switch to 90°C and check as temperature increases above 90°C RF Voltage and RF Current decrease.
6. Turn Function Switch to IMPEDANCE and note that Impedance Display lights up. Select Impedance on Test Box and check that Impedance Meter displays the correct impedance. ± 20%
7. Turn Function Switch to STIMULATE and check that Green Rate LED flashes at both 3Hz and 100Hz. Check with scope on Test Box that stimulate voltage is the correct shape and frequency. Range should be 0 to 2 volts.
8. With Test Box set to 200 ohm LOAD and Lesion Power Potentiometer turned on, switch Function Switch to LESION Position. Lesion power lamp should light together with RF Voltage, RF Current and Temperature Meters. A High Pitch sound should be heard.
9. Turn Lesion Power Potentiometer off, High pitch sound should cease. Turn Lesion Power Potentiometer On, Lesion Power On, LED should flash, and RF Voltage and RF Current Meters should move upscale with clockwise rotation of the Lesion Power Potentiometer.
10. Start Timer by rotating Start Timer Switch and releasing. Turn off Lesion Power using the potentiometer, note that clock stops. Turn on Lesion Power and when clock is restarted it should start from where it left off. Let Timer run to zero, Lesion Power should switch off and a high Pitch Tone should be heard. Tone ceases when Lesion Power Switch is turned off.

9.0 FUNCTIONAL FIELD CHECK PROCEDURES (continued)

11. Monitor shape of RF Lesion signal on Test Points on Test Box. At Maximum Power signal should be 110V peak to peak sine wave at approximately 300KHz.

12. Check that 60,90,120 and 180 seconds can be set on the Clock Timer by rotating the Set Time Switch.

13. Check the leakage current of the unit. Check the condition of all cables and connectors.

10.0 SPARE PARTS

10.01 Spare Parts

NOTE: Accessories are Listed in Operators Manual.

Item	Item Description	Order No.
1A	Primary Fuse EUR 1 AMP T TYPE	2800-020*
1B	Primary Fuse USA 2 AMP T TYPE	2800-021*
2	Power Supply Fuses 1 AMP T TYPE	2800-020*
3	Mains Entry Module with Switch	2800-023
4A	Mains Cable UK	2800-024*
4B	Mains Cable EUR	2800-025*
4C	Mains Cable USA	2800-026*
5	Transformer	2800-027
6	Alarm Buzzer	2800-028
7	Power Supply Board 2800808001	2800-001*
8	Impedance Board 2800808002	2800-002*
9	Stimulate Board 2800808003	2800-003*
10	RF Generator Board 2800808004	2800-004*
11	RF Voltage and Current Metering Board 2800808005	2800-005*
12	Temperature Board 2800808006	2800-006*
13	Timer and Interlock Board 28008008007	2800-007*
14	Front Panel complete with switches and meters and displays	2800-008
15	Enclosure	2800-029
16	Replacement Lamps for Meters	2800-030*
17	Kit of Fixings	2800-031*
18	Set of 4 feet with fixings	2800-032
19	Test Box	2800-033
20	Fuse Board	2800-009

* This part is recommended for stock

11.0 EARLIER REVISIONS

This section lists any technical details relevant to earlier versions of the Lesion Generator.

{The main body of this technical manual deals with the present production revision of the equipment}.

Serial Nos.	Relevant Technical Details

Morgan
The Intelligent
Application of
Technology

Rake Heath House
London Road
Hillbrow
Liss
Hants
GU33 7NT

Telephone
+44 (0) 1730 895900
Facsimile
+44 (0) 1730 895922

EC DECLARATION OF CONFORMITY

Morgan Automation Ltd. declares that the apparatus known as :-

Neurotherm – Model JK3

is in conformity with the following Standards and Requirements :-

BS EN 60601-1-2 : 1993
ISO 13485 : 1996
BS EN 46001 : 1994
BS 5724 Section 2:3 : 1983
BS 5724 Section 1:1 :1992 IEC 601-1-1:1992
Directive 93/42/EEC

Is subject to the procedure set out in Annex II of Directive 93/42/EEC under the supervision of Notified Body Number 0120, SGS Yarsley International Certification Services Ltd.

Signed :-.................................... Date : 3-12-98

Name ...H.M. CLARKE............. (Technical Director)

Ref: TECHFILE/NTDEC.doc

Morgan Automation Ltd. Reg. Office: Rake Heath House, London Road, Hillbrow, Liss, Hants GU33 7NT Reg. No. 2174066

RDG
MEDICAL
429 Brighton Road, South Croydon, Surrey, CR2 6EU, UK Tel: 0181-660 4374 Fax: 0181-660 9417

YEAR 2000 CONFORMITY

16th December 1997

General Statement

This is to confirm that the NeuroTherm RF Lesion Generator does not contain a date sensitive microprocessor or date sensitive programme.

ROD GEMMELL
Managing Director

International Tel: +(44) 181 660 4374 International Fax: +(44) 181 660 9417
E-mail: admin@rdgmedical.com www.rdgmedical.com
A division of Croydon Industries Limited Registered No: 1390305 (England)